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Study on Task Assignment of Two-stage Multi-service Capability Port Logistics Service Providers

Zhaowei Meng[1] Xiaoguang Wang[2*]

1. Institute of Logistics Science and Engineering, Shanghai Maritime University, Shanghai, 201306, China
2. Shanghai Lixin University of Accounting and Finance, Shanghai, 201306, China

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ABSTRACT

This paper mainly studies the problem of multi-task assignment of providers in port logistics service supply chain. As a core enterprise, port plays the role of logistics service integrator.With the continuous development of industrial integration, logistics service providers not only provide one kind of logistics service, but also develop into composite suppliers who capable of providing a variety of logistics services . This paper studies the task assignment problem of multi-service capability providers in the port logistics service supply chain. The two-stage logistics service provider task assignment model was built ,which is based on the mixed evaluation method (including MOORA and FMEA) and the multi-objective planning method. Eventually, the effectiveness of the model method was verified by combining with an example.

1. Introduction

In recent years, outsourcing services have become more and more popular, especially in the logistics service supply chain (LSSP), where the logistics service integrator (LSI) integrates the service capabilities of multiple functional logistics service providers (LSPs) to provide logistics services according to customer needs [1].

As the hub of a variety of transportation modes, the port is more complex in integrating logistics providers(that provides transportation, storage, handling, processing, distribution, customs clearance, freight forwarding, financial services and other services) [2]. It should not only consider the service cost and service time, but also strive to ensure that the customer are satisfied with the service. Integrator enterprises begin to consider the involvement of service outsourcing providers to help improve the satisfaction of end customers. When providers are satisfied, they are more willing to help enterprises meet customer needs. Therefore, the integrator enterprise needs to combine the satisfaction of providers and customers to achieve the optimal service [3]. However, in practice, some logistics providers gather and integrate their functional logistics capabilities(such as transportation, warehousing, distribution, etc.) to realize the re-subcontracting of logistics, and they no longer only provide a single logistics capability, but become a composite logistics service provider that can provide a variety of logistics service capabilities [4].Compared with a single functional logistics service provider, the selection of functional providers who have multiple capabilities not only facilitates the coordinated operation of transportation services, but also reduces service costs. For example, in the case that the service price is the same,

**Corresponding Author:*
Xiaoguang Wang,
Shanghai Lixin University of Accounting and Finance, Shanghai, 201306, China;
Email: wxg3695@163.com

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one logistics service provider can provide warehousing, processing and distribution services, while another can only provide warehousing services.It is Conceivable that logistics service integrators prefer to choose the former. Therefore, when the port assigns tasks to its long - term logistics service providers, it should not be limited to its service quality and quotation, but put it into the logistics service process to consider the coordination and rationality of task assignment.

Due to the differences in the qualification, reputation, operation standardization and customer satisfaction level of provider enterprises, and the customer's needs vary widely. Moreover, the service efficiency and quality of different services are also different for providers who are of multi-service capabilities. Therefore, it is necessary to evaluate the providers of port logistics service before task assignment. Researchers usually use multi-criteria decision making (MCDM) to evaluate the performance of providers. However, with the deepening of research, the risk faced by providers is also a key factor in the evaluation. Consider, for example, that a provider provides a lower cost of service, but pays 50 percent more than normal in an unsTablesituation.That is, taking into account only overall performance and ignoring the risk of increased costs [5].

In this paper, two methods which including ratio analysis (MOORA) and failure mode and impact analysis (FMEA), are used to evaluate the performance and risk of port logistics service providers respectively. And then a multi-objective planning model was built to assign tasks to providers with multiple logistics service capabilities. The structure of other parts of this paper are as follows: in Section 2, there is a literature review of logistics service provider evaluation and task assignment. Problem definition are stated in Section 3. Section 4 is the construction of provider evaluation and task assignment model. Section 5 validates the model with an example. Finally, conclusiona are provided in Section 6.

2. Literature Review

The evaluation of logistics providers is the premise of task assignment of port logistics service supply chain, which is of great significance to the development of port logistics. Provider evaluation is a multi-criteria decision problem. Common methods include analytic hierarchy process (AHP), analytic network analysis (ANP), case-based reasoning (CBR), data envelopment analysis (DEA), fuzzy set theory, genetic algorithm (GA), mathematical programming, simple multi-attribute rating technique (SMART) and a combination of them [6].At present, more and more new methods are used in provider evaluation and selection, such as VIKOR method, ratio analysis (MOORA), fuzzy MULTIMOORA and so on. Based on DEA and ANP, Zou Yong [7] established a two-stage logistics provider selection model to select the best provider. Zheng Yuxing [8] used AHP method to obtain the weight of the evaluation index of port logistics service provider, so as to select the provider. However, these methods only consider the performance of the evaluation indicators but ignore the risks of these indicators. For example, although the price of a provider's service is very low, if the price fluctuates greatly over a period of time and is difficult to detect, the evaluation result will be less scientific. You Jianxin [9] and Liu Wei applied the improved FMEA method to the provider's risk assessment. Amir Arabsheybani [10] used the fuzzy multi-criteria decision model based on ratio analysis (MOORA) to evaluate the overall performance of providers of household evaporative coolers, and assessed the provider's risk using failure mode and impact analysis (FMEA).

In previous studies, provider selection was typically followed by task assignment for the selected provider. However, in the actual task execution, it is impossible for an integrator to establish a cooperative relationship with only one provider to complete a logistics task, but to select the best one or several qualified providers from multiple functional supply enterprises for simultaneous cooperation. A logistics service of the integrator can be assigned to one or more suppliers, and the task assignment of the whole service supply chain can be combined into hundreds of results. Therefore, the optimal combination of providers can be selected through reasonable task assignment. Zhang wei [11] established a multi-objective programming model with the objectives of lowest total service cost, shortest service time, maximum provider satisfaction and minimum penalty intensity, and then transformed the multi-objective programming into a single-objective programming by using constraint method and linear weighting method. Although the above studies consider that a task can be assigned to multiple providers, they all focus on the task assignment of the provider with a single logistics capability, but regardless of the task assignment of the composite provider with multiple service capabilities. By classifying functional providers, Zhang Jingyang [12] successively constructed provider task assignment models with single logistics capability and multiple logistics capabilities. In this study, logistics integrators dominated, and providers could only choose to execute assigned tasks. Nevertheless, in the port logistics service chain, when the provider's satisfaction with the assigned task is low, the cooperation is likely to be abandoned. Liu Weihua [13] studied the task assignment problem of

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logistics service providers with uncertain demand for multi-logistics service capabilities, and constructed a task assignment model based on conditions such as integrator cost minimization, provider satisfaction maximization and penalty intensity minimization, and maximum matching between different capabilities.

All of the above studies are separate studies of provider evaluation and task assignment. But in practice, the limitation of service capability, service cost and time efficiency should also be considered when evaluating providers. Xiaojian Hu [14] established the optimal selection strategy and order distribution strategy of the functional logistics service provider under mass customization, and verified the model by using the improved genetic algorithm. The results of numerical analysis show that the optimal selection strategy of providers and order allocation strategy affect each other, but the weight of evaluation index is not considered in this study. Hacer GünerGören [15] improved this defect by using the decision fuzzy decision testing and evaluation laboratory (DEMATEL) method to improve the accuracy of evaluation results. Korpela J [16] proposed that the assignment of supply chain tasks should take into not only cost, efficiency and satisfaction, but also the importance and risk of providers, and proposed a solution combining AHP and MIP methods.

To sum up, this paper considers the establishment of a two-stage task assignment model for port logistics providers. In the first stage, the comprehensive evaluation value of port logistics service providers was obtained by using MOORA method and FMEA method. When a provider is assigned a task, its importance can be obtained by using the ratio of the provider's comprehensive evaluation value to the sum of the comprehensive evaluation values of all the provides who actually participate in the task. In the second stage, the evaluation results of the first stage were taken as input parameters, and the task assignment model of multi-objective planning port logistics service provider was established with the goal of minimum total supply chain cost and maximum overall satisfaction, which including customer satisfaction and provider satisfaction.

3. Problem Definition

The supply chain of port logistics service is a continuous process, different links need different logistics service providers who is of different service capabilities to complete. At present, in order to win a larger market share, nodal enterprises have begun to extend their business to form an operation branch chain with the enterprise as the core. At this point, the service capacity of enterprises is enhanced, forming a composite provider with a variety of logistics capabilities.

When the port enterprises as the core of the supply chain enterprises, it first divides the logistics task after receiving the customer's logistics order, and then selects the appropriate provider from the current database for task assignment. In order to improve the scientificity and rationality of task assignment, it is necessary to evaluate the providers to obtain their importance. Finally, the importance is taken as the input to analyze the task assignment problem of single port, multi-task and multi-provider, so as to achieve the optimal distribution of logistics tasks with the minimum total supply chain cost and the highest overall satisfaction.

4. Methods and Model

The method and model flow chart are shown in Figure 2:

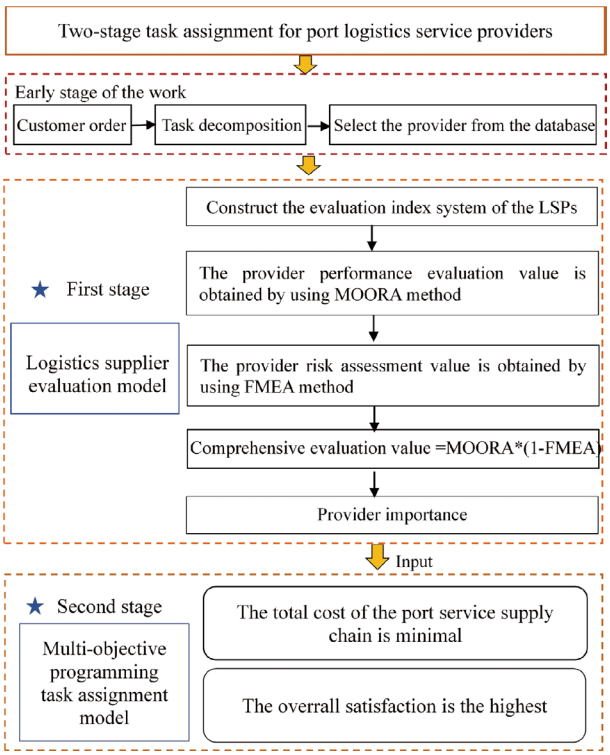

Figure 2. Method and model flow chart

4.1 Evaluation of Port Logistics Service Providers

(1) LSP performance was evaluated by fuzzy MOORA method

Ratio analysis multi-objective optimization (MOORA) is a multi-criteria decision-making method, which has great application potential for evaluating alternatives with multiple effective factors, while fuzzy MOORA method makes multi-criteria decision on qualitative conditions by using fuzzy language. The calculation steps of fuzzy MOORA method [17] are as follows:

Step 1. The decision matrix of *m* LSP and *n* evaluation

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indexes is expressed as:

$$\tilde{X}=\begin{bmatrix} \left[x_{11}^L, x_{11}^M, x_{11}^U\right] & \left[x_{12}^L, x_{12}^M, x_{12}^U\right] & \cdots & \left[x_{1n}^L, x_{1n}^M, x_{1n}^U\right] \\ \cdots & \cdots & \cdots & \cdots \\ \left[x_{m1}^L, x_{m1}^M, x_{m1}^U\right] & \left[x_{m2}^L, x_{m2}^M, x_{m2}^U\right] & \cdots & \left[x_{mn}^L, x_{mn}^M, x_{mn}^U\right] \end{bmatrix} \quad (1)$$

Step 2. Standardize the decision matrix $\tilde{X}$ in Step 1 through Eq.(2) - (5):

$$\tilde{r}_{ij}=\left(r_{ij}^L, r_{ij}^M, r_{ij}^U\right)=\left(\frac{x_{ij}^L}{x_{ij}^{L^*}}, \frac{x_{ij}^M}{x_{ij}^{M^*}}, \frac{x_{ij}^U}{x_{ij}^{U^*}}\right) \quad (2)$$

$$x_{ij}^{L^*}=\sqrt{\sum_{i=1}^{m}\left(x_{ij}^L\right)^2} \quad (3)$$

$$x_{ij}^{M^*}=\sqrt{\sum_{i=1}^{m}\left(x_{ij}^M\right)^2} \quad (4)$$

$$x_{ij}^{U^*}=\sqrt{\sum_{i=1}^{m}\left(x_{ij}^U\right)^2} \quad (5)$$

Step 3. Obtain the weight vector $\tilde{w}_j$ of experts' subjective evaluation of evaluation indicators by fuzzy AHP method [18]:

① Determine the hierarchical structure of the analytic hierarchy process according to the problem.

② The pairwise comparison matrix is formed by fuzzy evaluation of the indicators by experts, as shown in Table1.

③ Sum over all fuzzy Numbers.

④ Calculate the fuzzy number of each line and the ratio of Step 3 neutralization.

⑤ The weight of each index wj is obtained by the arithmetic mean value of each row.

⑥ Consistency checking.

Table 1. Fuzzy evaluation value of fuzzy AHP

Linguistic variables	Crisp Number	Triangular fuzzy number	Reciprocal triangular fuzzy number
Equal	1	(1,1,1)	(1,1,1)
Moderate	3	(1,1,3/2)	(2/3, 1,1)
Strong	5	(1,3/2,2)	(1/2,2/3,1)
Very strong	7	(3/2,2,5/2)	(2/5,1/2,2/3)
Extreme	9	(2,5/2,3)	(1/3,2/5,1/2)

Step 4. The weighted normalized decision matrix is obtained by multiplying the criteria by the weight *w*.

$$\tilde{v}_{ij}=\left(v_{ij}^L, v_{ij}^M, v_{ij}^U\right) \quad (6)$$

Step 5. The evaluation value of each LSP is obtained based on the ratio system.

$$\tilde{y}_i=\sum_{j=1}^{g}\tilde{v}_{ij}-\sum_{j=g+1}^{n}\tilde{v}_{ij} \quad (7)$$

where, *g* and *n*-*g* represent the number of benefit-type indicators and cost-type indicators, respectively. The higher $\tilde{y}_i$ is, the higher the evaluation of the corresponding LSP is.

Step 6. The normalized fuzzy performance value is converted to the non-fuzzy BPN value by the central method (COA).

$$BPN_i\left(\tilde{y}_i\right)=\frac{\left(y_i^U-y_i^L\right)+\left(y_i^M-y_i^L\right)}{3}+y_i^L \quad (8)$$

where, $\tilde{y}_i=\left(y_i^L, y_i^M, y_i^U\right)$.

(2) Evaluate LSP risk by fuzzy FMEA method

Failure mode and impact analysis (FMEA) which is an analytical method is used to determine the potential failure or risk of a product or system. The traditional FMEA method is to score the importance degree (S), occurrence degree (O) and difficulty degree (D) of the risk by the evaluator, then multiply the three and represent by RPN. The greater RPN is, the greater the risk of the corresponding failure mode is. However, the traditional FMEA method has many defects. This paper uses an improved method to calculate the risk value [17], and the calculation is as follows:

$$RPN_i=\left(\frac{(L-1)}{99}\right)^{ep}*100 \quad (9)$$

where, $L=S*O$, $ep=-0.1*D+1.55$.

The evaluation steps of FMEA method are as follows:

① The indexes of providers who were evaluated by historical data.

② Alculate the risk value of each provider by using Eq. (1) - (7).

(3) Calculate the comprehensive evaluation value

Performance value expresses the evaluation of LSP performance, while risk value expresses the evaluation of LSP risks.The comprehensive evaluation value of the ith

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LSP can be expressed as:

$$P_i = BPN_i\left(y_i\right)\times\left(1-RPN_i\right) \tag{10}$$

Then the importance of the *i*th LSP is:

$$\beta_i = \frac{P_i}{\sum_{i=1}^{m} P_i} \tag{11}$$

4.2 Build a Multi-objective Task Assignment Model

(1) Model describes

This model is used to solve the task assignment problem of multi-logistics capability providers.The logistics service integrator (LSI) breaks the logistics service into a sub-task by type and then assigns the task to the logistics service provider (LSP).Customer satisfaction is one of the service objectives of the supply chain. In addition, when LSP is not satisfied with the tasks assigned to it, it will have a negative attitude towards the tasks assigned to it, which will cause instability of the supply chain. Therefore, LSP's satisfaction needs to be considered. The purpose of this model is to achieve optimal task assignment for LSP with the goal of minimum total supply chain cost and maximum overall satisfaction.

(2) Model assumes

① A service may be assigned to one or more LSP, and a LSP may provide one or more logistics services.

② The port is LSI, and LSPs are subject to its distribution.

③ The services are conducted in sequence.

④ There is no damage or shortage of goods.

(3) Meaning of model index/parameters/decision variable

The meanings of model index/parameters/decision variable are shown in Table 2. In the table, logistics service providers are represented by LSP and ports are represented by LSI.

Table 2. Meaning of model index/parameters/decision variable

Index/ Parameters/ Decision variable	Meaning
S	The number of service types provided by the port logistics service integrator to the customer, S≥1
N	Number of LSPs, N > 1
K	Number of customers where goods are received
s	Index number of type of service (or task), $s \in \{1,2,...,S\}$
i, j	Index number of LSPs, $i, j \in \{1,2,...,N\}$
k	Index number destination customer
W	Total amount of goods
a_i	The order in which the services are provided by the ith LSP, $a_i \in \{1,2,...,S\}$
m	The LSP's index number that provides the end-to-end logistics service, $m \in \{m \mid a_m = S\}$
$\left[\theta_{is}^{-}, \theta_{is}^{+}\right]$	Capability interval of LSP *i* for the service in item *s*
$\theta_{is}^{\max}$	Maximum capacity of LSP *i* for the service in item *s*
θ_k	The quantity of goods required at the place of receipt *k*
β_{is}	Importance for the service in item s LSP i (which obtained from the previous stage)
l_{ij}	The distance between LSP *i* and the next LSP *j*, $j \in \{j \mid a_j = a_i + 1\}$
l'_{mk}	Distance between end LSP *m* and customer *k*
$\left[t_{is}^{-}, t_{is}^{+}\right]$	The time interval in which LSP *i* could provide the service in item s
$\left[tc_k^{-}, tc_k^{+}\right]$	The time interval for the final completion of the service requested by customer *k*
x_{is}	The proportion of the total number of tasks assigned by LSP *i* to provide services under the service in item *s*
λ_{is}	If LSP*i* is assigned the task of the service in item *s*, that is $x_{is} > 0$, $\lambda_{is} = 1$; otherwise $\lambda_{is} = 0$
r_{ij}	If there is a connection between LSP *i* and LSP *j*, then $r_{ij} = 1$; otherwise $r_{ij} = 0$
r'_{mk}	If there is a connection between LSP *m* and customer *k*, then r'_{mk} =1, otherwise $r'_{mk} = 0$
d_{is}^{0}	The initial satisfaction of LSP *i* with the assigned service in item *s*
d_{is}	The final satisfaction of LSP *i* with the assigned service in item s
$\tilde{d}$	The total satisfaction of all LSPs for all logistics services
tE_k	The most satisfactory time point for the delivery of goods to customer *k*
te_{is}	The point in time at which LSP *i* completes the service in item s(before the goods are transferred to LSP *j*)
ta_{ij}	The time point at which LSP *i* transfers the goods to LSP *j*, $j = \{j \mid r_{ij} = 1\}$
ta_i	The time at which the goods arrive at LSP *i*
ta'_{mk}	The time point at which LSP *m* transfers the goods to customer *k*, $m = \{m \mid r'_{mk} = 1\}$
ta_k	The time when the goods arrive at customer *k*

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tw_i	The time when the goods wait to be served at LSP *i*(The short storage time when the goods arrive earlier than the earliest start time t_{is}^{-})
$c1_k$	Unit waiting cost for goods to arrive at customer before tc_k^{-}
$c2_k$	Unit delay cost of goods arriving at customer after tc_k^{+}
$CS_{is}\left(x_{is}\right)$	The cost function of the service cost ,which is the cost of service in item *s* provided by LSP *i*
$CT_{ij}\left(x_{is},l_{ij}\right)$	The cost function of transfer cost of goods from LSP*i* to LSP *j*
$CH_{is}\left(x_{is},tw_i\right)$	The cost function of LSP *i* for the short-term storage cost of the goods
$CT_{mk}^{'}\left(x_{ms},l_{mk}^{'}\right)$	The transfer cost function of goods from LSP*i* to customer *k*
$CF_{mk}\left(ta_k^{'},x_{ms}\right)$	The penalty cost function that provider *m* failed to deliver to customer *k* within the time frame $\left[tc_k^{-},tc_k^{+}\right]$
$TS_{is}\left(x_{is}\right)$	The time function of the time required for LSP *i* to provide the service in item *s*
$TT_{ij}\left(x_{is},l_{ij}\right)$	The time function that is required for the transfer of goods from LSP*i* to LSP*j*
$TT_{mk}^{'}\left(x_{ms},l_{mr}^{'}\right)$	The time function that is required for the transfer of goods from LSP*m* to customer *k*
$E_{mk}\left(ta_k^{'}\right)$	The satisfaction function of customer *k*'s satisfaction with the delivery time of *m*

(4) Model building

The objective function and constraints are as follows:

$$\min Z=\sum_{i=1}^{N}\sum_{s=1}^{S}\lambda_{is}\left(CS_{is}+CH_{is}\right)+\sum_{i=1}^{N}\sum_{j=1}^{N}r_{ij}CT_{ij}+\sum_{m}\sum_{k=1}^{K}r_{mk}^{'}\left(CT_{mk}^{'}+CF_{mk}\right) \tag{11}$$

$$\max M=\tilde{d}+\sum_{m}\sum_{k=1}^{K}E_{mk}/K \tag{12}$$

s.t.

$$\sum_{i=1}^{N}\lambda_{is}=1,s\in\left\{1,2,..,S\right\} \tag{13}$$

$$\sum_{j=1}^{N}r_{ij}=1,\forall i\in\left\{1,2,...,N\right\} \tag{14}$$

$$0\le x_{is}W\le\theta_{is}^{\max},\forall i\in\left\{1,2,...,N\right\} \tag{15}$$

$$ta_i+TS_{is}\le t_{is}^{+},\forall i\in\left\{i\mid\lambda_{is}=1\right\} \tag{16}$$

$$\beta_{is}=\frac{P_{is}}{\sum_{i=1}^{m}\lambda_{is}P_{is}} \tag{17}$$

$$\sum_{i=1}^{N}\beta_{is}=1,s\in\left\{1,2,...,S\right\} \tag{18}$$

$$tw_i=\max\left\{0,t_{is}^{-}-ta_i\right\},i\in\left\{i\mid\lambda_{is}=1\right\} \tag{19}$$

$$te_{js}=\lambda_{js}\left(\max\left\{\max_{j}\left\{ta_{ij}\right\},t_{js}^{-}\right\}+TS_{js}\right),i\in\left\{1,2,...,N\right\},\ j\in\left\{j\mid r_{ij}=1\right\} \tag{20}$$

$$ta_{ij}=te_{is}+TT_{ij},i\in\left\{1,2,...,N\right\},j\in\left\{j\mid r_{ij}=1\right\} \tag{21}$$

$$CF_{mk}\left(ta_k^{'},x_{ms}\right)=\begin{cases}c1_k x_{ms}W\left(tc_k^{-}-ta_k^{'}\right), & 0<ta_k^{'}<tc_k^{-}\\ 0, & tc_k^{-}\le ta_k^{'}\le tc_k^{+}\\ c2_k x_{ms}W\left(ta_k^{'}-tc_k^{+}\right), & tc_k^{+}<ta_k^{'}\end{cases} \tag{22}$$

$$d_{is}=\begin{cases}\dfrac{\theta_{is}^{+}}{x_{is}W}d_{is}^{0}, & \theta_{is}^{+}<x_{is}W\le\theta_{is}^{\max}\\ d_{is}^{0}+\dfrac{x_{is}W-\theta_{is}^{-}}{\theta_{is}^{+}-\theta_{is}^{-}}\left(1-d_{is}^{0}\right), & \theta_{is}^{-}\le x_{is}W\le\theta_{is}^{+},i\in\left\{1,2,...,N\right\}\\ \dfrac{x_{is}W}{\theta_{is}^{-}}d_{is}^{0}, & 0\le x_{is}W<\theta_{is}^{-}\end{cases} \tag{23}$$

$$\tilde{d}=\sum_{i=1}^{N}\sum_{s=1}^{S}\beta_{is}d_{is} \tag{24}$$

$$E_{mk}\left(ta_k^{'}\right)=\begin{cases}\left[1+\dfrac{\left(ta_k^{'}-tE_K\right)^2}{tE_K}\right]^{-1}, & tc_k^{-}\le ta_k^{'}\le tc_k^{+}\\ 0,\text{Others}\end{cases} \tag{25}$$

Objective function (11) represents the minimum total cost of the port logistics service supply chain, while objective function (12) represents the highest total satisfaction of providers and customers. Constraint (13) and (14) indicate that the port logistics service provider must complete logistics services for all goods. Constraint (15) limits the

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amount of goods allocated to the *i*th LSP to no more than its maximum service capacity. Constraint (16) requires that the *i*th LSP complete the task within the time interval during which the service is available. Equation (17) is the calculation of importance.In constraint (18), the sum of the importance of the LSP who providing the same service is 1. Constraint (19) represents the time for goods to wait for service at the *i*th LSP. Equation (20) represents the time point at which the *j*th LSP completes the service task of item *s*. Equation (21) is the point in time at which the goods are transferred from *i* to *j*. Equation (22) represents the penalty cost for failure to deliver within the time frame required by the customer. Equation (23) represents LSP's satisfaction with assigned tasks, and equation (24) represents the total satisfaction of all suppliers for all logistics services. Customer satisfaction with delivery time is expressed in equation (25).

(5) Solution method of model

The above model belongs to the multi-objective programming model and aims to minimize the total cost and maximize the overall satisfaction.In this paper, the objective function (11) is transformed into a constraint condition by using the constraint method, so that the multi-objective function is transformed into a single-objective function. The specific steps are as follows:

Without considering the objective function (12), the optimal solution Z* is obtained by solving the single-objective programming model with the minimum total service cost as the objective.When the objective function (11) is transformed into a constraint condition (26), the multi-objective programming problem is transformed into a single-objective programming problem to obtain the maximum overall satisfaction.

$$Z \le (1+\delta) Z^* \tag{26}$$

where, δ is a relatively small integer, which is called "relational cost coefficient". For example, when δ=10%, it can be understood that in order to establish a good cooperative relationship with LSPs, the LSI is willing to bear the "relationship cost" 10% higher than the minimum cost, and thinks that this investment can get greater returns in the future.

5. Case Study and Results

5.1 Case Description

There is a batch of 100t of goods in port A that needs to be transported to the factories of two customers in city B, B1 and B2. The demand for B1 and B2 is 40t and 60t respectively. The goods need to be processed simply and transported by sea and land. As shown in Figure4, the goods start from port A and arrive at port C, which is closer to B, and then are delivered to the customer's factory B1 and B2.

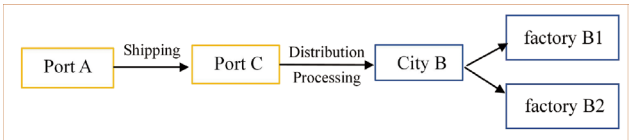

Figure 4. Schematic diagram of a port logistics transportation service

After being screened by the provider database, There are 3, 1, 3 and 3 logistics service providers respectively providing shipping services, port services, simple processing services and distribution services in the whole service supply chain, as shown in Table3 (there S_i represents the *i*th LSP). The LSPs information of each service is shown in Table3-6, the customer information of the place where the goods are received is shown in Table7, and Table8 represents the distance between SLPs and SLPs and the customer.

Table 3. The types of services that the port LSPs can provide in the service supply chain

Service item type	S1	S2	S3	S4	S5	S6	S7	Number of LSPs
Shipping	√	√	√					3
Port service				√				1
Processing		√			√	√		3
Distribution			√			√	√	3

Table 4. Shipping and port service provider information

Index	Shipping service SLPs			Port service SLPs
	S1	S2	S3	S4
$\left[\theta_{is}^{-}, \theta_{is}^{+}\right]$	[20,50]	[30,120]	[30,70]	[50,200]
$\theta_{is}^{\max}$	60	150	100	300
$\left[t_{is}^{-}, t_{is}^{+}\right]$	[0,10]	[0,7]	[0,9]	[3,10]
d_{is}^{0}	0.5	0.6	0.5	0.8
$CS_{is}(x_{is})$	$1500+200x_{11}W$	$2000+450x_{21}W$	$1000+270x_{31}W$	$200+150x_{42}W$
$CH_{is}(x_{is}, tw_i)$	0	0	0	$(100+300x_{i1}W)tw_4$
$CT_{ij}(x_{is}, l_{ij})$	0	0	0	$100+20x_{j3}l_{4j}W$
$TS_{is}(x_{is})$	3.2	2.0	2.5	$0.05+0.03x_{42}W$
$TT_{ij}(x_{is}, l_{is})$	0	0	0	$0.03+0.01l_{4j}$

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Table 5. Processing service provider information

Index	Processing sercice SLPs		
	S2	S5	S6
$\left[\theta_{is}^{-},\theta_{is}^{+}\right]$	[40,80]	[50,80]	[30,60]
$\theta_{is}^{\max}$	120	100	80
$\left[t_{is}^{-},t_{is}^{+}\right]$	[6,15]	[2,15]	[3,12]
d_{is}^{0}	0.5	0.7	0.6
$CS_{is}\left(x_{is}\right)$	$250+155x_{23}W$	$300+150x_{53}W$	$200+130x_{63}W$
$CH_{is}\left(x_{is},tw_{i}\right)$	$(130+42x_{23}W)tw_{2}$	$(150+40x_{53}W)tw_{5}$	$(100+30x_{63}W)tw_{6}$
$CT_{ij}\left(x_{is},l_{ij}\right)$	$70+18x_{23}l_{2j}W$	$70+20x_{53}l_{5j}W$	$65+14x_{63}l_{6j}W$
$TS_{is}\left(x_{is}\right)$	$0.1+0.03x_{23}W$	$0.1+0.04x_{53}W$	$0.08+0.02x_{63}W$
$TT_{ij}(x_{is},l_{is})$	$0.02+0.01l_{2j}$	$0.02+0.015l_{5j}$	$0.02+0.012l_{6j}$

Table 6. Distribution service provider information

Index	Distribution service SLPs		
	S3	S6	S7
$\left[\theta_{is}^{-},\theta_{is}^{+}\right]$	[50,80]	[40,100]	[50,100]
$\theta_{is}^{\max}$	120	120	120
$\left[t_{is}^{-},t_{is}^{+}\right]$	[4,20]	[2,22]	[0,15]
d_{is}^{0}	0.6	0.7	0.7
$CS_{is}\left(x_{is}\right)$	$300+10x_{34}W$	$200+12x_{64}W$	$150+16x_{74}W$
$CH_{is}\left(x_{is},tw_{i}\right)$	$(90+22x_{34}W)tw_{3}$	$(100+14x_{64}W)tw_{6}$	$(150+20x_{74}W)tw_{7}$
$CT_{mk}^{'}(x_{is},l_{ml}^{'})$	0	0	0
$TT_{mk}^{'}\left(x_{ms},l_{mr}^{'}\right)$	$0.015+0.015l_{3k}^{'}$	$0.015+0.001l_{6k}^{'}$	$0.02+0.001l_{7k}^{'}$

Table 7. Customer information sheet of the place where the goods were received

Index	θ_k	β_k	$\left[tc_k^{-},tc_k^{+}\right]$	$c1_k$	$c2_k$	tE_k
1	40	0.5	[18,28]	0.8	1.2	18
2	60	0.5	[15,19]	0.7	1.4	15

Table 8. Distance between SLPs, SLPs and customers

SLP/ Customer		Port	Processing			Distribution			Customer	
	S4	S2	S5	S6	S3	S6	S7	K1	K2	
Port	S4		4.0	3.5	3.0					
Processing	S2					2.0	2.3	1.5		
	S5					3.1	1.8	2.0		
	S6					2.8	0	3.5		
Distribution	S3								7.5	8.3
	S6								8.8	6.2
	S7								5.2	7.0

5.2 Providers' Importance Calculation

In the form of questionnaires, the provider evaluation index system of the port logistics service supply chain is constructed from three aspects which including economy, resources and society, as shown in Table 9, and the evaluation index is fuzzy evaluated through Table 10.

Table 9. Evaluation index system of port logistics service providers

	First-class index	Second-class index
Evaluation of port logistics service providers (A)	Economic(B_1)	Operating conditions(C1)
		Cost(C2)
		Service(C3)
		Management(C4)
	Resources(B_2)	Pollution(C5)
		Technology(C6)
	Social(B_3)	Cooperation and sharing(C7)
		Quality of employees(C8)
		Enterprise image(C9)

Table10. The corresponding trigonometric fuzzy value of the language variable of the evaluation index

Linguistic variable	Level	Triangular fuzzy value
Very low(VL)	1	(1, 1, 3)
Low(L)	2-4	(1, 3, 5)
Medium(M)	5-6	(3, 5, 7)
High(H)	7-9	(5, 7, 9)
Very high(VH)	10	(7, 9, 9)

In order to facilitate the calculation, shipping service is taken as an example for calculation. The evaluation results of experts are shown in Table13.

Table 11. Evaluation results of shipping service providers

LSP / Indexc	S1	S2	S3
C1	(3, 5, 7)	(5, 7, 9)	(5, 7, 9)
C2	(5, 7, 9)	(5, 7, 9)	(1, 3, 5)
C3	(7, 9, 9)	(5, 7, 9)	(3, 5, 7)
C4	(5, 7, 9)	(5, 7, 9)	(5, 7, 9)
C5	(1, 3, 5)	(3, 5, 7)	(1, 3, 5)
C6	(5, 7, 9)	(7, 9, 9)	(3, 5, 7)
C7	(3, 5, 7)	(5, 7, 9)	(7, 9, 9)
C8	(5, 7, 9)	(3, 5, 7)	(3, 5, 7)
C9	(5, 7, 9)	(3, 5, 7)	(1, 3, 5)

The fuzzy AHP method in Step 3 of MOORA method is used to obtain the weight vector $\tilde{w}_j$ which is experts' subjective evaluation of the evaluation index,and the results are shown in Table 12. Then, as shown in Table 13,

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Table 12. Evaluation index weight calculation

A-B	B_1	B_2	B_3	Weight	Final weight
B_1	(1,1,1)	(3/2,2,5/2)	(1,3/2,2)	(0.500,0.532,0.523)	(0.500,0.532,0.523)
B_2	(2/5,1/2,2/3)	(1,1,1)	(2/3, 1,1)	(0.211,0.217,0.191)	(0.211,0.217,0.191)
B_3	(1/2,2/3,1)	(1,1,3/2)	(1,1,1)	(0.289,0.251,0.286)	(0.289,0.251,0.286)
B_1-C	C_1	C_2	C_3	C_4	Weight	——
C_1	(1,1,1)	(1/2,2/3,1)	(1/2,2/3,1)	(1,1,3/2)	(0.214,0.202,0.222)	(0.107,0.107,0.116)
C_2	(1,3/2,2)	(1,1,1)	(2/3, 1,1)	(1,1,3/2)	(0.274,0.273,0.264)	(0.137,0.145,0.138)
C_3	(1,3/2,2)	(1,1,3/2)	(1,1,1)	(1,3/2,2)	(0.303,0.302,0.314)	(0.152,0.161,0.164)
C_4	(2/3, 1,1)	(2/3, 1,1)	(1/2,2/3,1)	(1,1,1)	(0.208,0.223,0.200)	(0.104,0.119,0.105)
B_2-C	C_5		C_6		Weight	——
C_5	(1,1,1)		(1,1,3/2)		(0.551,0.500,0.551)	(0.116,0.109,0.105)
C_6	(2/3, 1,1)		(1,1,1)		(0.449,0.500,0.449)	(0.095,0.109,0.086)
B_3-C	C_7	C_8	C_9		Weight	——
C_7	(1,1,1)	(3/2,2,5/2)	(1,1,3/2)		(0.492,0.440,0.465)	(0.781,0.691,0.751)
C_8	(2/5,1/2,2/3)	(1,1,1)	(1/2,2/3,1)		(0.180,0.180,0.196)	(0.469,0.431,0.482)
C_9	(2/3, 1,1)	(1,3/2,2)	(1,1,1)		(0.328,0.381,0.339)	(0.617,0.632,0.625)

the weighted normalized decision matrix of maritime service providers is obtained by combining Table 11.

Table 13. Weighted normalized decision matrix

LSP / Indexc	S1	S2	S3
C1	(0.022, 0.048, 0.106)	(0.037, 0.068, 0.136)	(0.037, 0.068, 0.136)
C2	(0.050, 0.098, 0.174)	(0.050, 0.086, 0.143)	(0.010, 0.037, 0.080)
C3	(0.073, 0.116, 0.162)	(0.052, 0.090, 0.162)	(0.031, 0.065, 0.126)
C4	(0.033, 0.068, 0.109)	(0.033, 0.068, 0.109)	(0.033, 0.068, 0.109)
C5	(0.012, 0.050, 0.159)	(0.035, 0.083, 0.222)	(0.012, 0.050, 0.159)
C6	(0.033, 0.061, 0.085)	(0.046, 0.078, 0.085)	(0.020, 0.044, 0.066)
C7	(0.161, 0.278, 0.577)	(0.269, 0.389, 0.742)	(0.376, 0.500, 0.742)
C8	(0.175, 0.303, 0.662)	(0.105, 0.217, 0.515)	(0.105, 0.217, 0.515)
C9	(0.248, 0.486, 0.951)	(0.149, 0.374, 0.740c)	(0.050, 0.208, 0.528)

According to Eq.(1)-(7), the performance value of each SLP is calculated through the implementation of the the MOORA method, and the clear value is obtained according to equation (8), as shown in Table 14.

Table 14. Evaluation results of shipping service providers

SLP	Fuzzy performance value	Non-fuzzy performance values	Rank
S1	(0.684, 1.212, 2.318)	1.405	1
S2	(0.606, 1.088, 2.122)	1.272	2
S3	(0.630, 1.082, 1.983)	1.232	3

Similarly, the evaluation results of other service providers (as the optional port service only has S4, it is not evaluated) are shown in Table15.

Table 15. Other LSP performance evaluation results were obtained by using MOORA method

Service type	SLP	Fuzzy performance value	Non-fuzzy performance values
Processing	S2	(0.505,0.936,1.949)	1.431
	S5	(0.713,1.250,2.331)	1.130
	S6	(0.684,1.206,2.355)	1.415
Distribution	S3	(0.610,1.054,1.926)	1.367
	S6	(0.657,1.137,2.219)	1.338
	S7	(0.668,1.187,2.217)	1.197

The FMEA method was implemented with shipping service as an example. Experts evaluated the S, O and D with risks in all SLPs evaluation indicators according to the questionnaire results. The risk indicators were described as shown in Table 16.

Table 16. Risk indicators description

Module	Index	Potential risk
Economic (B1)	C1	It mainly refers to financial risks, such as debt service, profitability, reduced operational and reduced development capacity
	C2	It mainly refers to the price fluctuation, the cost is higher than the market price
	C3	Delivery of goods with low accuracy and completeness
	C4	Poor management and coordination skills

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Resources (B2)	C5	Carbon emission overshoot
	C6	Low ownership of technical facilities and equipment or low application rate in this service
Social (B3)	C7	The degree of information sharing is low
	C8	Staff professional quality is low and education level is not high
	C9	Poor customer evaluation

RPN of each SLP is obtained from equation (9), which is multiplied by the weight of each indicator to obtain the comprehensive RPN value. Finally, according to equations (10) and Table 14 and Table 15, the comprehensive evaluation value as shown in Table 17 can be obtained.

Table 17. Assessment results of all LSPs

Service type (*s*)	SLP(*i*)	RPN value	Comprehensive evaluation value (P_{is})
Shipping	S1	0.133	1.218
	S2	0.247	0.958
	S3	0.339	0.814
Port service	S4	--	--
Processing	S2	0.119	1.429
	S5	0.523	1.124
	S6	0.259	1.411
Distribution	S3	0.139	0.801
	S6	0.247	1.007
	S7	0.614	1.038

5.3 The Multi-objective Task Assignment Model is Used to Solve the Problem

Tasks were assigned to logistics service providers according to the model, and the evaluation results obtained in Section 4.2 were represented by P_{is}, which was input into the model to obtain the importance of the supplier. The model was solved by combining with an example. In this paper, Lingo12.0 programming was used to solve the problem [19].

(1) Considering only the objective function where the service cost is minimal, the minimum value of the total logistics service cost is Z^*=75793.8. Here we take δ =1%, and convert Eq.(11) into the constraint condition $Z \leq (1+1\%) \times Z^*$, that is, $Z \leq 76551.6$.

(2) Under the premise of satisfying the constraint (13) - (16), the single objective program with the greatest overall satisfaction is obtained. The results of task assignment are as follows:

x_{11}=58%, x_{21}=15%, x_{31}=27%, x_{42} =100%, x_{23} =40%, x_{63} =60%, x_{64} =60%, x_{74} =40%. Overall satisfaction M=0.581, Total cost Z=76082.2.

(3) Results contrast

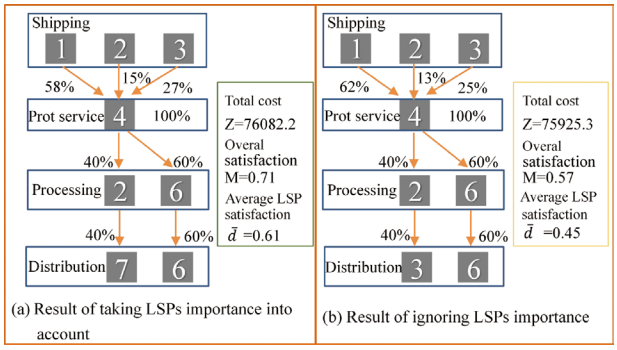

Figure 5. Result of considering importance and ignoring importance

As shown in Figure 5, when the importance of providers is not considered, the overall satisfaction is 0.57, and the average provider satisfaction is 0.45. On the other hand, when considering the importance of providers, although the total cost increased by 156.9, the overall satisfaction reached 0.71, and the satisfaction of providers also improved.

6. Conclusion

This paper mainly studies the task assignment of port logistics service providers with multi-service capabilities. In addition, the concept of provider's importance is also introduced. The calculation results show that the selection of multi-service capability providers can reduce the cost. For example, the selection of processing and distribution services from provider S6 can effectively reduce the transfer cost and transfer time, thus improve the efficiency of the supply chain. Furthermore, considering the importance of providers increase the overall satisfaction although it increases the cost slightly, which is of great significance to maintain the stability of the supply chain.

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REVIEW

Expected Investment Premium in China Capital Market

Di Liu*

Central University of Finance and Economics, Chinese Academy of Finance and Development, China

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ABSTRACT

Through a measurement of corporate investment plan, i.e. expected investment cash flow growth (EICFG), which combines historical equity issuance and factors that influence firm's future investment, this paper studies the impact of investment expectation on firm's cross-sectional return of stock in China capital market. I document the negative correlation between EICFG and future stock return in A-share market, and find out that stocks of firms with higher growth of investment cash flow performs significantly worse than those with lower growth of investment cash flow in one year. Our long-short EICFG portfolio generates a statistically and economically significant return which cannot be captured by leading factor models. I further disentangle the covariation between EICFG and expected stock return from rational and behavioral perspective. This paper also extends the research of investment premium to investment-based asset pricing model.

1. Introduction

Investment premium has been a hot issue in asset pricing research field recently. Basic economics and finance theory show that firm's investment decision has a great impact on their operation performance as well as stock return performance. Many literatures discover the significant covariance between firm's investment decision and its stock performance, both on firm-level and aggregate level, although the relation is still mixed.

On aggregate level, Cochrane [1] construct an investment-to-capital ratio (I/K) to study the relation between aggregate investment and capital market return. His research on the US market reveals a significant negative correlation within aggregate investment and stock market performance, although this relation would be weakened by dividend yield. Lamont [2] finds out a significant predicting power of firm's investment plan on future stock return in the US market: those years with high investment generate low market return, while high investment expectations generate low future market return. Arif and Lee [3] discover a co-movement between aggregate investment and investors' sentiment in their study of the US public market. When investors' sentiment index peaks, aggregate investment hits a high level as well, followed by a negative abnormal return afterward. This negative correlation between aggregate investment and future market return is still robust after adding controlling variables such as PE ratio, book-to-market ratio, credit spread, term spread, equity issuance and so on. They also expand the research to global market and find the similar relation in 13 out of 14 developed capital market. On the other hand, Hirshleifer, Hou and Teoh [4] give us a different story when they analyze operating accruals and future stock return. As an investment indicator, operating accruals is positively cor-

**Corresponding Author:*
Di Liu,
Central University of Finance and Economics, Chinese Academy of Finance and Development, China;
Email: 474846044@qq.com

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related with market return in the future.

On firm-level, this relation is also controversial. Cooper, Gulen and Schill [5] study the US market and find out asset growth has a strong explanatory power to firm's cross-sectional return. A long-short portfolio based on total asset growth of last fiscal year demonstrates a significant negative abnormal return. Moreover, this negative relation between asset growth and firm's stock performance can last for longer than 5 years. Using last 3-years moving average capital expenditures as a proxy of firm's investment, Liu, Whited and Zhang [6] has a similar finding in the US market that firms with higher capital expenditure generate a lower average return in next period. A research of Cooper and Priestley [7] summarize that for the US public firms, their actual investment are negatively correlated with future stick return, with measurements of I/K, total assets growth and total investment growth. On the contrary, Li and Wang [8] find different relation when they study on firms' expected investment rather than actual investment. By constructing an expected investment growth variable EIG, they discover a strong and positive relation between firms' expected investment and future stock return. A long-short portfolio based on EIG deciles generates a positive abnormal return in the US market and other G7 countries. However, using a similar approach, Li, Wang and Yu [9] find that aggregate market expected investment growth is negatively covaried with future market return, indicating that the effect of expected investment on future stock return might be volatile.

Naturally, we are also interested in the mechanism behind investment premium. Some scholars (Liu, Whited and Zhang [6], Li and Zhang [10], Cooper and Priestley [7], Arif and Lee [3], Gennaioli, Ma and Shleifer [11]) try to explain it from risk pricing aspect. They argue that assuming firms' investment has a lag, which means firms cannot adjust their investment immediately, when discount rate falls, on one side, the hurdle rate falls, leading to higher investment level; on the other side, risk premium falls as well, indicating a lower future return. Therefore, with existence of investment lag, more investment encounters with lower return. However, Li and Wang [8] point out that unsystematic characters of the firm also play an important role and cash flow effect of the investment might overweight interest rate effect, resulting to a synchronous change within expected investment and future stock return.

Inspired by them, this paper tries to investigate the impact of investment expectation on stock return in China capital market. Firm's investment plan is determined by various factors, including interest rate, investors sentiment, risk preference, liquidity pressure, etc. With risk pricing theory, I decompose investment decision-making parameters into systematic one and idiosyncratic one. From the perspective of systematic risk, when risk-free rate drops, the IRR of investment falls as well, resulting to a higher level of future investment. Meanwhile, current stock price rises due to lower discount rate, leading to a lower future stock return. Therefore, investment expectation is negatively correlated to future stock return. From the perspective of idiosyncratic risk, in spite of the fact that firm-specific factors may have complicated impact on investment decision-making process, for those who decided to increase their investment, assuming they are rational, market expectation of their earnings will rise. Such expectation reflects a higher current stock price, meaning a lower future return.

According to Chinese accounting principle for public firms, investment cash flow for purchase of fixed assets, intangible assets and other long-term assets can be regarded as capital expenditure. In this paper, I study the impact of expected investment cash flow growth (EICFG) on cross-sectional return in China capital market and find out that EICFG has a strong predicting power on firm's stock return and for those firms with higher investment expectations, they will experience a lower abnormal return in next period. This paper applies the risk pricing theory in the study of investment premium and elaborate the correlation behind it comes from interest rate and profitability, contributing to related research in China capital market.

The rest of this paper is organized as followed: Section II describes the sample and variables. Section III is empirical analysis and discussion. At last, a conclusion will be made in Section IV.

2. Sample Selection and Variable Construction

Sample

After a reform in 2006, most of Chinese public firms can liquidate their common stocks in the capital market. So our sample selects the data from 2006 to 2019 in *CSMAR*, a wildly used financial database, including financial statement reports, monthly return profile, market return profile and etc. After excluding financial industry and utility industry, the sample leaves us 260,251 entries.

EICFG

I combine the approach of Li and Wang [8] and that of Pontiff and Woodgate [12] to construct our main explained variable EICFG as two stages.

At stage I, I do the cross-sectional regression for all public firms on April of year t with the model (1):

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$$ICFG_{i,t} = \alpha + b_{MOM,t} * MOM_{i,t-1} + b_{q,t} * q_{i,t-1} + b_{CF,t} * CF_{i,t-1} + b_{ISSUE,t} * ISSUE_{i,t-1} + \varepsilon \quad (1)$$

where $ICFG_{i,t}$ is the actual investment cash flow growth of firm i at year t, i.e. the natural logarithm of investment cash flow at year t over that at year t-1; $MOM_{i,t-1}$ is the momentum factor of firm i at year t-1 comes from Jegadeesh and Titman [13]; $q_{i,t-1}$ is the q factor of firm i at year t-1 which is the natural logarithm of firm's market value over its total equity; $CF_{i,t-1}$ is the cash flow measurement of firm i at year t-1 which is the sum of net income before extraordinary items and depreciation divided by total equity; $ISSUE_{i,t-1}$ is the equity issuance of firm i at year t-1 comes from Pontiff and Woodgate [12].

At stage II, I use the estimated parameters *a*, $b_{MOM,t}$, $b_{q,t}$, $b_{CF,t}$ and $b_{ISSUE,t}$, together with latest MOM, q, CF and ISSUE, to calculate EICFG of firm i on each month. This method guarantees that EICFG only contains public information and avoids forward-looking problem.

Fama-MacBeth [14] regression of model(1) on full sample shows that MOM, q, CF and ISSUE can explain the actual investment growth, in hence they have good predicting power to expected investment.

Table 1. Fama-MacBeth regression analysis of ICFG

	ICFG				
Intercept	0.111	-0.059	0.086	0.117	-0.000
	[1.38]	[-0.65]	[0.93]	[1.12]	[-0.01]
MOM	0.171***				0.139**
	[3.41]				[2.39]
q		0.077***			0.036**
		[4.40]			[2.01]
CF			0.100***		0.065**
			[3.71]		[2.35]
ISSUE				0.007*	0.132**
				[1.85]	[2.20]
Adj R-square	0.002***	0.001***	0.002***	0.001***	0.006***
	[3.12]	[5.33]	[4.14]	[4.30]	[8.09]

Note: Robust t-statistics with Newey-West [15] corrections are reported in the parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.

Univariate analysis of MOM, q, CF and ISSUE demonstrate that estimated parameters are at least significant at 10% level. A higher historical return, market value, cash inflow or historical equity financing will lead to a higher investment. Multivariate analysis presents a similar implication at 5% level. Therefore, MOM, q, CF and ISSUE are good indicators for actual investment growth and EICFG can be a good proxy for investment expectation.

3. Empirical Analysis and Discussion

At the end of each month, I sort all firms into 10 groups by computed EICFG value from low to high. The descriptive statistics is presented in table 2, where EICFG is the growth of expected investment cash flow, ICFG is the growth of actual investment cash flow, Size is the natural logarithm of firm's market value, B/M is firm's book-to-market ratio, MOM is the momentum variable comes from Jegadeesh and Titman [13], q is tobin's q facor, CF is the measurement of firm's cash flow and ISSUE is a proxy of equity financing comes from Pontiff and Woodgate [12].

Table 2. Descriptive statistics of EICFG portfolio

EICFG rank	EICFG	ICFG	Size	B/M	MOM	q	CF	ISSUE
Low	-0.083	0.173	22.234	0.372	-0.170	2.487	0.093	0.029
2	-0.035	0.218	22.228	0.381	-0.063	2.406	0.283	0.048
3	-0.012	0.292	22.239	0.379	0.014	2.350	0.324	0.067
4	0.007	0.257	22.276	0.372	0.082	2.330	0.358	0.096
5	0.026	0.318	22.288	0.375	0.149	2.309	0.393	0.149
6	0.045	0.327	22.356	0.368	0.222	2.321	0.444	0.234
7	0.068	0.322	22.424	0.359	0.308	2.327	0.503	0.355
8	0.097	0.296	22.541	0.344	0.420	2.361	0.594	0.491
9	0.141	0.283	22.719	0.327	0.591	2.418	0.745	0.673
High	0.287	0.420	23.059	0.293	1.106	2.531	1.336	1.002

As we can see, EICFG deciles generally express a low to high trend in ICFG. The size and book-to-market ratio for each decile have minor differences, and for those firms with higher EICFG, their historical return, cash flow and historical equity financing is higher as expected.

Then we construct the return matrix for 10 EICFG portfolios as presented in table 3, where Portret is annualized 1-month buy-and-hold return, CAPM_Alpha is annualized CAPM adjusted abnormal return, FF-Alpha is annualized Fama-French 3-factor model adjusted abnormal return, FRET_1Y is 1-year buy-and-hold return, FRET_2Y is 2-year buy-and-hold return and FRET_3Y is 3-year buy-and-hold return. I also construct a zero investment portfolio each month by long low EICFG decile and short high EICFG decile, and examine the return of this long-short portfolio. The empirical result shows that EICFG is negatively correlated to future stock return, i.e. firms with lower investment expectation outperform those with higher investment expectation. The long-short portfolio that update each month based upon EICFG deciles realize an annual return of 11.5%, which is statistically and economically significant. This abnormal return is not captured by both CAPM and Fama-French 3-factor model as the model adjusted alphas are 9.1% and 6.8%, respec-

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tively. With a longer investment horizon, if we hold the long-short portfolio for three years, in first year, its raw return is 14.2%, even higher than that of holding for one month. In second year, its raw return plunges to 3.8% and in third year, it even generates a negative return of -8.5%. As my long-short portfolio updates in a monthly basis, the predicting power of EICFG is more profound in a shorter investment horizon.

Table 3. Return matrix of EICFG portfolio

EICFG rank	Portret	CAPM_ Alpha	FF-Alpha	FRET_1Y	FRET_2Y	FRET_3Y
Low	0.218	0.185	0.088	0.231	-1.019	-1.255
2	0.207	0.173	0.076	0.238	-0.994	-1.256
3	0.218	0.184	0.082	0.238	-0.991	-1.239
4	0.237	0.205	0.098	0.222	-0.998	-1.231
5	0.186	0.158	0.061	0.210	-1.003	-1.232
6	0.206	0.177	0.079	0.203	-1.014	-1.227
7	0.183	0.157	0.063	0.185	-1.019	-1.200
8	0.164	0.143	0.052	0.161	-1.023	-1.216
9	0.136	0.111	0.034	0.136	-1.043	-1.199
High	0.103	0.093	0.020	0.089	-1.057	-1.170
Low-High	0.115***	0.091**	0.068**	0.142***	0.038*	-0.085*
t-stats	[2.58]	[2.14]	[2.05]	[5.89]	[1.91]	[-1.87]

Note: Robust t-statistics with Newey-West (1987)[15] corrections are reported in the parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.

Based on return matrix, I also run a Fama-MacBeth regression of firms' excess return to investigate the comovement of EICFG and one-month leading return. Regression analysis contains size, book-to-market ratio, momentum and actual investment ICFG as control variables. Empirical result in table 4 shows that expected investment variable EICFG has a correlation coefficient of -0.052 with a t-stat of -4.46. After controlling firm size, book-to-market ratio, momentum and actual investment, such negative correlation is still significant in 1% level.

Table 4. Fama-MacBeth regression of firms' excess return

	Excess Return				
Intercept	-0.047***	-0.026***	-0.268***	-0.268***	-0.269***
	[-11.86]	[-8.15]	[-7.69]	[-7.66]	[-7.81]
EICFG	-0.052***	-0.017***	-0.036***	-0.043***	-0.042***
	[-4.46]	[-5.56]	[-7.82]	[-7.30]	[-7.03]
B/M		-0.049***	-0.048***	-0.046***	-0.046***
		[-8.69]	[-8.61]	[-7.18]	[-7.24]
ln(ME)			0.011***	0.011***	0.011***
			[7.38]	[7.15]	[7.32]
MOM				0.004***	0.004***
				[8.14]	[7.96]
ICFG					-0.001***
					[-3.86]
Adj R-square	**0.010*****	**0.011*****	**0.017*****	**0.018*****	**0.018*****

Note: Robust t-statistics with Newey-West [15] corrections are reported in the parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.

Now we are interested in the logic behind the negative correlation between expected investment and future return. In finance theory, the net present value of a project is determined by two factors, discount rate and future cash flow. If firm's investment decision is rational, expansion of investment comes from a fall of interest rate, or a rise in future cash inflow, or both. If interest rate falls, expected return of the firm falls as well. If future cash flow rises, a better earning expectation will reflect on current stock price, resulting to a higher present value and lower expected return. A Fama-MacBeth regression of firms' ROE presented in table 5 demonstrates that firm's investment expectation covaries with its profitability at 1% level of significance, after controlling size, book-to-market ratio and actual investment. Also, firm's ROE is positively correlated to firm's actual investment. An expansion of investment leads to a higher expectation of profit, a higher stock price and a lower future return.

Table 5. Fama-MacBeth regression of firm's ROE

	ROE			
Intercept	0.030***	0.017***	-0.285***	-0.282***
	[8.94]	[7.04]	[-8.40]	[-6.68]
EICFG	0.095***	0.104***	0.081***	0.080***
	[8.10]	[7.61]	[6.22]	[5.59]
B\M		0.032***	0.034***	0.034***
		[5.54]	[5.23]	[5.33]
ln(ME)			0.014***	0.013***
			[4.76]	[3.98]
ICFG				0.001***
				[3.83]
Adj R-square	**0.074*****	**0.089*****	**0.121*****	**0.122*****

Note: Robust t-statistics with Newey-West [15] corrections are reported in the parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.

4. Conclusion

This paper disentangle the correlation between firm's investment expectation and future return through an EICFG variable that measures firm's expected investment cash flow growth. The empirical analysis of China public firms

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from 2006 to 2019 shows that there exists a significant and negative relation between EICFG and future stock return. Firms with lower expected investment outperform those with higher expected investment in a short holding period. The zero investment portfolio by a long position in lowest EICFG decile and a short position in highest EICFG decile generates an annual return of 11.5% if we update the portfolio in a monthly basis, which is statistically and economically significant. Such anomaly cannot be mitigated by mainstream assets pricing model, such as CAPM and Fama-French 3-factor model. The predicting power of expected investment growth is better in a short horizon (within one year) than a long horizon.

I further investigate the logic behind firm's investment expectation and future stock return. In general, assuming that firm's investment decision is rational, expansion of investment comes from either a fall of interest rate, or a rise in future cash inflow. If interest rate falls, expected return of the firm falls as well. And if future cash flow rises, a better earning expectation will reflect on current stock price instantly, resulting to a lower expected return. Firm's investment expectation covaries with its profitability. Also, firm's ROE is positively correlated to firm's actual investment. An expansion of investment leads to a higher expectation of profit, a higher stock price and a lower future return.

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ARTICLE

A Study On the Structural Dimension of Middle Class Relational Identification in Chinese Context

Yunxia Su[1,2*] Minggui Sun[3]

1. Shanghai Publishing and Media Institute, Shanghai, 200093, China
2. Shanghai Publishing and Printing College, Shanghai, 200093, China
3. Donghua University, Shanghai, 200051, China

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ABSTRACT

Through in-depth interviews, this study makes an exploratory study on the dimension of the middle class relational identification in Chinese context by using the grounded theory. It is mainly composed of 4 dimensions: relational orientation, relational adaptation, relational evaluation and relational development. According to the four dimension model of middle class relational identification, the middle class relational identification in China is the cognitive and behavioral orientation that in the action of achieving a certain purpose, because of the perception of consistence with each other in role cognition and personal cognition, the middle class is willing to unite and trust, respect and understand and coordinate the conflict to adapt to this relationship, and then to form a positive evaluation of the relationship and a sense of belonging and commitment to this relationship. The construction of the structural dimension of middle class relational identification in China is conducive to explaining the endemic phenomena of Chinese middle class.

1. Introduction

The cultural and social temporal and spatial differences of the concept of the middle class make it different in different social and cultural contexts, such as "middle bourgeoisie", "middle class", "white-collar" and so on, which are collectively referred to as the middle class in this study. In the process of modernization around the world, the rise and growth of the middle class is a universal phenomenon, as is the case in China. Cultivating and developing the middle class is conducive to narrowing the gap between the rich and the poor, and enhancing the stability and coordination of development. The consumption behavior of the middle class will not only promote its individuals and families, but also promote the social and economic development of China in the transitional period. Its consumption concept and lifestyle may affect the energy consumption structure and ecological environment of China and the world [1].

The consumption of different social classes has the characteristics of stratification. Occupation, education, personal and family income are the important factors affecting the consumption of the middle class in China [2]. Beyond the traditional class symbols of occupation, group and income, Hart and Negri put forward the concept of

**Corresponding Author:*
Yunxia Su,
Shanghai Publishing and Media Institute, Shanghai, 200093, China;
Shanghai Publishing and Printing College, Shanghai, 200093, China;
Email: sunnysu545@126.com

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focus, and defined the social middle layer with creative labor and open network connection. Bourdieu believes that the set of class positions embodied in the consumption stratification can be explained either by introducing a set of party mechanism or by the "class spirit" produced by the words of intellectuals [3]. The latter is exactly how Hart and Negri say that the symbolic labor of creative non-material production occupies all social life [4].

The concept of identification originates from sociology, and social identification is based on the formation of social identity of social individuals. There are great differences in the composition of the middle class in China. The obvious heterogeneity and differentiation in social interaction rules and behavior norms, consumption behavior, lifestyle and other aspects are not conducive to the internal formation of a consistent middle class identity and class consciousness [5]. If cultural factors such as identity and consciousness are ignored, middle class research will encounter many unanswerable questions [6].

Relationship identification is a kind of identification related to interpersonal relationship. According to consumer sociology, Chinese identification management is a kind of external and objective identification management based on relationship self. It attaches great importance to obtaining positive evaluation from society and others, establishing identification with others by means of tangible goods and transmitting identification [7]. At present, in China, the modern society of the middle class itself flows frequently, and it is easy to produce a sense of "anxiety" of unstable social status. Cultural anthropologists believe that goods can "create and maintain social relations" [8], and the middle class will create a network of personal survival and development through gift consumption and confirm their own existence [9]. Because of the great differences in the composition of the middle class in Chinese context, they can only obtain the identification within the class from a narrower perspective, such as the common consumption characteristics [7], the dual relationship in the workplace [10], etc. In addition, the function of the family to determine the class boundary in Chinese society is prominent, and the fuzzy boundary of the middle class has been transformed into a clear and internal family boundary [4], the relational identification will be a feasible perspective to explain the phenomenon of middle class in China.

The theoretical construction and empirical research of relational identification has become a hot topic in the fields of organizational behavior and psychology in the west [11], while the relevant research is still quite lacking in China. It should be noted that "relationship" in Chinese context is different from that in the west, and whether the connotation of relational identification is different from that in the West needs to be studied. In addition, some foreign studies regard the measurement of relational identification as a single dimension construct, and many measurement studies directly adapt the social identification or organizational identification scale, and the measurement objects are limited to the colleague relationship and superior subordinate relationship in the organizational context [10,11]. Therefore, it is necessary to explore the nature of relational identification of middle class in Chinese context, develop dimensions and measurement scales of relational identification covering multiple role relationships, so as to unify the structure and measurement of relational identification. This study will explore the dimensions of relational identification of middle class in Chinese context, and understand its connotation, in order to provide a feasible research perspective to explain the unique phenomenon of Chinese middle class.

2. Literature Review

2.1 The Concept and Characteristics of Relational Identification

The definition of relational identification in academic circles has two perspectives: state view and process view [12]. From the perspective of state view, it emphasizes the cognitive relationship between the actor and the role relationship, and then determines the dynamic response of the actor to a certain relationship. Relational identification is the self-construction of an individual according to a specific role relationship [13], and it is the cognition of the actor whether there is a specific relationship between himself and others in the purposeful action [14]. What's different is that Sluss and Ashforth [13] emphasize the basic role of individual characteristics in relational identification, while Wang [14] emphasizes that individuals regard others as a means to realize their own values or interests. Therefore, the former thinks that relational identification has three characteristics of personification, interpersonal attraction and role sublimation, while the latter thinks that relational identification has two characteristics of others' direction and relationship operation. From the perspective of process view, it describes the process in which an individual obtains self-construction from the role relationship. Process view can explain the formation and change of relationship operation [12]. The state view of relational identification is closely related to the process view. Various factors that affect the relationship affect the process of relational identification, which will change the state of relational identification at a certain point.

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2.2 Dimension and Measurement of Relational Identification

Scholars at home and abroad have not reached a consensus on the connotation of relational identification. Is relational identification a multi-dimensional construct or a single dimensional construct? If it is a multidimensional construct, which dimensions should be included? What is the relationship between dimensions? How to operate the concept? So far, there is a lack of relevant research at home and abroad.

There are two ways to develop the scale of relational identification: one is to develop the scale of relational identification based on the scale of other constructs, the other is to directly develop the scale of measurement. The former, such as adapting social identification scale to measure subordinates' relational identification with leaders [15], adapting organizational identification scale to measure employees' relationship identity with customers [16], these scales do not go through strict scale development procedures, and it is difficult to use other structured scales to reflect the connotation of relational identification. The latter, for example, Walumbwa and Hartnell [17] developed a scale with 10 items to measure subordinates' relational identification with leaders, Zhang et al. [18] developed a scale with 7 items to measure employees' relational identification with colleagues, all of which are single-dimensional, with no significant difference in structure, content and measurement indicators [11].

Foreign scholars mostly study three directions from the perspective of ordinary organization members: "subordinates' role identification with leaders, employees' role identification with colleagues, employees' role identification with external stakeholders of the organization". In China, there are "ten-identifications" in relational identification [19], and kinship identification is the core of Chinese relational identification. In addition, Chinese people will adjust the scope of relational identification according to the needs of their instrumental actions. The expansion of the scope of relational identification means that Chinese people may absorb more non kinship relationships and their resources into the actions to support their instrumental goals [14]. The life style of the middle class involves many aspects such as family, work, study and interest, and its role relationship inevitably presents diversity. Therefore, in addition to the cultural differences between the East and the West, it is necessary to deeply understand the connotation of the relational identification of the middle class in Chinese context, understand its dimension structure, and develop a scale covering multiple role relationships on this basis to unify the structure measurement of relational identification.

3. Research Design

3.1 Research Method

In order to understand the connotation and dimensions of relational identification of middle class in Chinese context, this study mainly uses qualitative research methods. Qualitative research emphasizes the process, situation and concreteness of research, which is more suitable for the study of relational identification of middle class in Chinese context. In the process of the research, the open questionnaire method, in-depth interview method and grounded theory method are used to obtain and analyze the data, and then refine the structural dimension and clarify its connotation.

3.2 Data Sources

There is no unified standard for the definition of Chinese middle class. Different scholars put forward different views according to the research needs. In recent years, the commonly used standard of stratum division is the comprehensive use of income, education and vocational indicators [20]. Based on this criterion, the study defines the education standard as junior college or above, the occupational middle class as those who always or often need rapid thinking and mental work in their work, and the income standard as individuals with an annual income of more than 20000 yuan [21]. The individuals who meet these three indicators and any two indicators are defined as middle class.

Based on this standard, 21 middle-class people who work and live in Shanghai are selected as samples, 12 men and 9 women, aged between 30 and 45 years old; among them, 1 junior college degree, 6 bachelor's degree, 10 master's degree and 4 doctor's degree; the occupation distribution is: 1 ordinary clerk, 11 enterprise and business unit directors, 9 university teachers; the income distribution is: the minimum annual income is 90000 yuan, and the maximum annual income is 24 ten thousand yuan （Considering the fact that the per capita disposable income of Shanghai residents in 2017 was 58988 yuan, the housing price was expensive and the pressure of family education expenditure was huge, this study regards the per capita annual income of Shanghai households above 90000 yuan and within 300000 yuan as the middle range of income）. Therefore, all 21 samples meet the criteria of middle class.

3.3 Information Acquisition

In this study, in-depth interviews were used to collect the

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required information. In the in-depth interview, a pair of half-structured interviews were used, and the interview time for each person was controlled at 45-90 minutes. With the consent of the interviewees, the whole interview was recorded. After the interview, the recordings were sorted word by word, and nearly 50000 words of interview records were obtained.

The interview content includes: the interviewees introduce their basic information, including age, education background, job title and responsibilities, general income level, political status, marital status, etc.; after briefly explaining the scope of the "ten-identifications" relationship to the interviewees, the interviewees explain their understanding of the identified relationship, and give examples of an identified relationship and a non- identified relationship respectively, so the relational attribute, the causes of the relationship, how to play their roles, how to deal with contradictions, the factors that affect the relationship, how to evaluate the relationship between themselves and the people around them, the significance of the relationship to themselves, the current and future expectations of the relationship, etc.

Twenty one interviewees provided 42 relationship cases, including 15 cases involving the relationship with parents, parents in law and spouses, 8 cases involving the relationship with classmates, 14 cases involving the relationship with colleagues (including the relationship between superiors and subordinates), 4 cases involving the relationship with friends, and 1 case involving the relationship with lovers, which basically involved the work, study, family and hobbies of the middle class.

Then, grounded theory was used to code and model the interview content, to refine the structural dimension of relational identification of middle class.

3.4 Reliability and Validity Test

Grounded theory is a research method developed by Glaser and Strauss [22]. Based on empirical data, new concepts and ideas can be abstracted under the support of empirical data. In this study, we use grounded theory to analyze data and strictly abide by Strauss and Corbin's procedural coding process and method [23]. In order to ensure the reliability and validity of the research, avoid the subjective bias and academic conclusion of researchers, two graduate students were invited to form a coding group. In the process of research, the coding team members carry out data labeling and coding together. When there are different opinions, they discuss each other until they agree. Based

Table 1. Open Coding

Data Content	Open Coding	
	Defining Phenomenon	**Preliminary Conceptualization**
We used to be classmates, but now we are all college teachers. The road of development is the same.	We have a common goal.	In this relationship, our goals are the same.
I'm her daughter. She raised me when I was a child. When I grow up, I want to honor her. This is natural. I think I should do this. For her, I think she should raise me when she gave birth…….I hope that the other side will do this.In fact, it's basically like this.	Our understanding about roles is consistent.	In this relationship, our actions reflect a consistent understanding of what each should do.
When I have a need, he will appear at once and discuss with each other when I encounter problems.	When we are in trouble, we help each other.	When we encounter problems, we will work together to solve them.
Months after her daughter was born, as a mother, she was reluctant to breastfeed in order to maintain her body shape.	The other party is unwilling to take more responsibilities.	This relationship plays a role in many complex responsibilities and multitasking.
It takes a lot of tests to get a doctor's degree. There are certain difficulties in these levels. If the younger martial sister doesn't pass this level, will she complain that I didn't fully tell her my experience? Would she mind? But for a long time, she should not, how to say, everyone's ability is limited, and I can't help her completely, I think so.	When your ability is not enough to help the other, it will not affect the relationship between the other and yourself.	When one's ability is not enough to help the other solve complex tasks, mutual relationship will not be affected.
I have a lot of work to do myself. I can't help myself. The leader is not considerate at all. When I refuse, she called me a lot that day to ask me to do what she should do for her. I can't bear it.	She doesn't respect my opinions and choices.	She/he respects me and is willing to accept my choice or take my suggestions.
There is no contradiction between us. If there is one, it is a rare one, ……, he should be jealous, but then he immediately returned to normal, and the relationship with me is still the same as in the past. I think he is good, even if envy is normal, ……, I choose to understand him.	When there is a conflict, we give way to each other.	When there are conflicts, I will reflect on myself and be willing to compromise for mutual satisfaction.
If you meet a good leader or colleague at work, he will also help you a lot and tell you some experience.	Good relationships promote learning and improvement.	This relationship is conducive to learning and progress.
People around us all say that we are friends. People around us still agree with our relationship. Even because she started to get along with my other classmates who I didn't get along well with ,because her, we became a small group.	People around us recognize our friendship.	People in my circle recognize our relationship; People in his / her circle recognize our relationship.
I even think that in the future, we can live in the same place and help each other. In fact, we have such expectations for such a future.	If the relationship continues, it will be a happy thing.	Hope to continue mutual support and encouragement in the future.

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on the working time of the research, a memorandum is established for each comprehensive coding and theoretical refining work, recording the process of theoretical construction and modification [24].

4. Category Extraction and Model Construction

4.1 Coding Analysis of Grounded Theory

According to the grounded theory coding process of Strauss and Corbin [23], this study analyzes the interview data in three steps: open coding, relational coding and core coding.

4.1.1 Open Coding

Open coding is the process of decomposing and labeling the original interview materials sentence by sentence or paragraph. The purpose of tagging sentences or paragraphs is to conceptualize them and to group related concepts into a category to achieve categorization. In this study, we first extract the specific phenomenon about dimensions of relationship identification of middle class from the interview data, then summarize the phenomenon to form the concept, and extract the similar concept to form the category. In this process, 127 original statements are extracted and 39 free nodes are formed after conceptualization. In categorization, the initial concept with less frequency is eliminated and 21 free nodes are finally established. See Table 1 for the initial concepts and some category examples obtained by open coding.

4.1.2 Relational Coding

The concepts and categories established by open coding are independent of each other, and relational coding is the process of discovering and establishing the relationship between categories. According to the framework of paradigm structure process, the researchers logically sorted out the concepts and categories established by open coding as a whole, further produced the core categories, and explained the phenomena theoretically [23]. According to the free nodes obtained from the initial conceptualization, this study concludes eight categories: individual cognition, role cognition, solidarity and trust, respect and understanding, coordinating conflicts, relationship self-evaluation, relationship social evaluation and relationship outlook. The corresponding relationship between each category and the initial concept is shown in Table 2.

Table 2. Relational Code

Initial Concept (Free Node)	Relationship with Tree Nodes	Tree Node (Categorization)
In this relationship, our goals are the same.	Influence	Individual Cognition
In this relationship, our values are the same.	Influence	
In this relationship, I know what I should do.	performance	Role Cognition
In this relationship, I know what he / she should do.	performance	
In this relationship, our actions reflect a consistent understanding of what each should do.	Influence	
We trust each other.	Influence	Solidarity and Trust
When we encounter problems, we will work together to solve them.	Influence	
Celebrate each other's achievements and be happy for each other.	Influence	
This relationship plays a role in many complex responsibilities and multitasking.	Influence	
When one's ability is not enough to help the other solve complex tasks, mutual relationship will not be affected.	Influence	
I respect him/her and am willing to accept his/ her choice or take his/ her advice.	Influence	Respect and Understanding
She/he respects me and is willing to accept my choice or take my suggestions.	Influence	
When there are conflicts, I will reflect on myself and be willing to compromise for mutual satisfaction.	Influence	Coordinating conflicts
In case of conflict, he/ she will reflect on himself/herself and be willing to compromise for mutual satisfaction.	Influence	
We have a good relationship, get along with each other happily and harmoniously.	Influence	Relationship Self-evaluation
This relationship is conducive to learning and progress.	Influence	
People in my circle recognize our relationship.	Influence	Relationship Social Evaluation
People in his/her circle recognize our relationship	Influence	
I hope this relationship will last.	Influence	Relationship Outlook
Hope to continue mutual support and encouragement in the future.	Influence	
Hope for common development and progress in the future.	Influence	

4.1.3 Core Coding

In the core coding stage, after systematically analyzing

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the conceptual genera found in relational coding, the core genera are searched, and the core genera are connected with other categories to verify their relationship. According to the eight categories in Table 2, four core categories are further summarized: relational orientation, relational adaptation, relational evaluation and relational development. See Table 3 for the specific corresponding relationship.

Table 3. Core Code

Tree Node (Categorization)	Core Code
Individual Cognition	Relational Orientation
Role Cognition	
Solidarity and Trust	Relational Adaptation
Respect and Understanding	
Coordinating conflicts	
Relationship Self-evaluation	Relational Evaluation
Relationship Social Evaluation	
Relationship Outlook	Relational Development

4.1.4 Theoretical Saturation Test

In this study, new concepts and categories can no longer be generated when supplementary investigation data are used. Therefore, theoretical saturation test is adopted.

4.2 Dimension Model and Connotation Definition of Relational Identification

In the structural dimension model of relational identification of middle class in Chinese context relationship, the four dimensions of relational orientation, relational adaptation, relational evaluation and relational development are the core categories, which affect the relational identification of middle class. Among them, relational orientation is the foundation, which is composed of individual cognition and role cognition. It reflects the cognition of both sides about each other's role and the other side in a relationship, and provide the carrier of the role and individual characteristics of the bearing relationship for the relationship identification. Relational adaptation is the "umbrella", which consists of solidarity and trust, respect and understanding, and coordinating conflicts. It provides relational norms and process strategies for relational identification. Relational evaluation provides relational reflection, which is composed of relationship self-evaluation and relationship social evaluation. It is reflected in the emotional and cognitive evaluation of an individual for a certain relationship as well as a broader cognitive evaluation. The more a relationship is recognized by everyone, the more recognition of their roles will be strengthened. Relational development guides the development of a relationship, and then realizes the continuity and unity of its past, present and future.

According to the model, this study holds that relational identification of Chinese middle class is the middle class's cognitive and behavioral orientation in realizing a purposeful action, because the actor perceives the consistency of role cognition and personal cognition with the relationship partner, and is willing to adapt to the relationship through solidarity and trust, respect and understanding, and coordinating conflicts, and then form a positive evaluation of the relationship, as well as a sense of belonging and commitment to the relationship.

5. Document Dialogue

Based on in-depth interview and grounded theory, this study abstracts four structural dimensions of relational identification of middle class in Chinese context, and finds that these four structural dimensions have solid theoretical basis through dialogues with existing domestic and foreign studies.

The dimension of relational orientation includes two sub dimensions: individual cognition and role cognition. According to Sluss and Ashforth [13], relational identification is based on relationship identity, which includes role-based identity and personal identity, reflecting how the two parties play their respective roles. At the sub dimension level of individual cognition, narrative psychology based on the concept of "narrative" focuses on how people organize behaviors and give meaning through narrating life stories, and how to construct themselves in this process. Relational identification has personality characteristics. When one identifies a relationship, the characteristics and personality of the other will be fully considered [13]. At the sub dimension level of role cognition, according to the symbolic interaction theory, the individual's self-role is formed in the social interaction with others and changes with time [25]. In the context of Chinese culture, Chinese people will use different exchange rules because of different relationship attributes, that is, the exchange principle between family members is responsibility and obligation, the exchange principle between relatives and friends is reciprocity, and the exchange principle between strangers adopts the instrumental principle [26]. The essence of the pattern of differential order relationship in Chinese society is the response of Chinese people to the cognition of role relationship.

The dimension of relational adaptation includes three sub dimensions: solidarity and trust, respect and understanding, and coordinating conflicts. The relational identification takes the relational attribute as the standard of

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identification, emphasizes to abide by the behavior norm under a certain relationship attribute, and both parties of the relationship must bear the responsibilities and obligations in the relationship [26]. For example, Chinese society requires children to be "filial" to their parents, which actually requires their children to respect and obey their parents. The sub dimension of solidarity and trust and the sub dimension of conflict and coordination belong to the category of relationship norms, which reflect the common understanding and expectation of both parties and can build and create a harmonious relationship atmosphere [27]. Social exchange theory describes the individual's perception of the exchange relationship with each other, and emphasizes the comparison between their own exchange relationship and other members' exchange relationship. In general, the parties to the relationship need to prove their mutual loyalty (i.e., unity), a common interest relationship (i.e., reciprocity), willingness to assume multiple responsibilities (i.e., integrity of roles), belief adjustment (i.e., flexibility), and a tendency to resolve conflicts harmoniously (i.e., coordinate conflicts) [28]. At the sub dimension level of respect and understanding, social support theory can explain that one's relational identification with the other is an indicator of obtaining social support from the other. To respect and understand each other means to give each other face, to recognize the social status or reputation of the other [29], and to obtain social support from the other.

The dimension of relational evaluation includes two sub dimensions: relationship self-evaluation and relationship social evaluation. At the sub dimension level of relationship self-evaluation, when one provides enough social support and meets the emotional and instrumental needs of the other, the other can positively evaluate the role relationship and form relational identification [30]. Relational identification has the characteristics of interpersonal attraction and role sublimation [13]. When both sides of the relationship agree with the relationship, friendship may be formed beyond the boundaries of formal roles. In China, the intensity of emotional relationship among family members, relatives and friends, and between strangers decreases in turn. According to the resource allocation model of Hwang [31], the possibility of resource allocators accepting resource allocation requests is a function of the closeness of the relationship between allocators and applicants, and the latter is a function of emotional level, reciprocity (human feelings), and "face" to applicants in turn. In addition, social learning theory holds that a good relationship can make one party of the relationship become a model and encourage the other party to actively imitate it, so that both parties can internalize the nature and characteristics of the relationship and improve the relational identification [11]. On the sub dimension level of relationship social evaluation, generally speaking, the more a group of related role relationships are recognized by the collective, the stronger the recognition of both parties to their roles will be. Collective recognition can come from other individuals or from a broader social background [25].

The dimension of relational development includes a sub dimension of relationship outlook. According to the theory of self-narration, in the process of constructing the relational identification, the relational identification can be seen as one of the parties who narrates by connecting the past and the present experiences. Relational identification is not only a state, but also a process of change. Relational identification from the perspective of process view can explain the formation and change of relational identification [12]. Therefore, relational identification is developed after a certain point of time. Whether and how to extend and change in the future also needs attention.

6. Conclusion and Agenda

6.1 Main Contributions

First of all, this study clarifies the connotation of relational identification of middle class in Chinese context. Relational identification of middle class in Chinese context is the middle class's cognitive and behavioral orientation in realizing a purposeful action, because the actor perceives the consistency of role cognition and personal cognition with the relationship partner, and is willing to adapt to the relationship through solidarity and trust, respect and understanding, and coordinating conflicts, and then form a positive evaluation of the relationship, as well as a sense of belonging and commitment to the relationship.

Secondly, it constructs the structural dimension model of relational identification of middle class in Chinese context. In this model, relational orientation, relational adaptation, relational evaluation and relational development are the 4 core dimensions. These 4 core dimensions affect the relational identification of middle class. Among them, relational orientation includes two sub dimensions: individual cognition and role cognition, relational adaptation includes three sub dimensions: unity and trust, respect and understanding, coordinating conflicts, relational evaluation includes two sub dimensions: relationship self-evaluation and relationship social evaluation, and relational development includes one sub dimension: relationship outlook.

6.2 Shortcomings of This Study

First of all, although the sample selection of this study

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conforms to the sample selection criteria, all the interviewees come from the same city. These interviewees work, study and live in the same city in China. Therefore, whether the research on the structural dimension of relational identification of middle class has universal significance is still uncertain. In the future, we need to expand the regional coverage of the samples to improve the generality of the research conclusions.

Secondly, this study lacks of quantitative research. This study mainly uses qualitative research methods. Therefore, the research conclusion lacks the support of quantitative data and quantitative research.

6.3 Future Research Prospects

This study draws four structural dimensions of relational identification of middle class in Chinese context. At present, there is a lack of research in this area in China. Therefore, this study not only opens up the existing research on relational identification, but also provides a new perspective for the study of the unique phenomenon of middle class in Chinese context. The future research can be improved in two aspects: first, to develop the measurement scale of structural dimensions of relational identification of middle class in Chinese context to provide operable technical basis for the follow-up empirical research; second, to expand to the fields of consumer behavior, consumer sociology, consumer economics, organizational behavior, psychology and other disciplines, further excavate its antecedent and outcome variables, explore the relationship between relational identification and other variables, and pay special attention to its possible negative impact.

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ARTICLE

Competition and Profitability of Banks: Empirical evidence from the Middle East & North African (MENA) Countries

Syed Moudud-Ul-Huq* **Md. Abdul Halim** **Tanmay Biswas**

Department of Business Administration, Mawlana Bhashani Science and Technology University

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ABSTRACT

This paper uses generalized method of moments (GMM), Least Squares (LS) and Generalized Linear Model (GLM) to examine the impact of competition on profitability of banks and Stochastic Frontier approach (SFA) is used to estimate of cost efficiency. We have used an unbalanced panel dataset from a sample of emerging economic MENA countries over the period between 2011 and 2017. We find out that have a significant and negative impact of competition on profitability of banks. The empirical findings of this study suggest that (1) MENA banks should more improve the process of managing and monitoring the loan segment business ; the result which reducing in the level of credit risk which leads to higher profitability (2) MENA banks should shrink higher level of banking sector development. (3) MENA banks should make full conduct of available funds to engage in various natures of businesses; if there is an issue of insolvency, robust government support would give protection to MENA banks. Finally, it also provides some compulsory policy implications which will be very much beneficial for a wide range of stakeholders.
JEL: G10; G21

1. Introduction

Financial reforms required in the area Middle East and North Africa (MENA) in favor of International Monetary Fund (IMF) during the period 1980s and 1990s.These reform had affected significantly in banking systems and local stock market in MENA region [31].

In the traditional structure conduct refers that in the banking industries have the effect of competition on the profitability. It represents that if the concentration is the higher, the competition will be the lower which forces to obtain higher profit [37,38,40].

Else, the efficient structure hypothesis emphasizes to take efficiency which leads to higher profitability. To measure the efficiency cost to income ratio is used and different results were found [3,12].

They used joint banking products (total deposit, gross loan and non-interest income) to examine the impact of competition on profitability Chinese commercial banks over the period 2003 to 2013 [38].

This study investigates the impact of the competition in different banking markets on profitability of different ownership structure (Islamic banks, Commercial Banks and Specialized Govt. Institution). The purpose of this study is to show the impact of competition on profitability of banks in MENA region. For that reason, this study contributes to the contemporaneous empirical analyses in some ways. 1st, on this field, several various nations like

**Corresponding Author:*
Syed Moudud-Ul-Huq,
Department of Business Administration, Mawlana Bhashani Science and Technology University;
Email: moudud_cu7@mbstu.ac.bd

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US banking industry, European banking industry, Greek banking industry and China banking industry has focused a lot of attention where lately MENA have focused to handle this sophisticated issue, but there have a few evidence of research on this area. Thus, this paper is to investigate MENA countries banks with a broader range of unbalance panel data that covers 256 banks and 19 countries over the period from 2011 to 2017. 2nd, some studies focused mostly on the impact of credit risk, liquidity risk, capital risk, and insolvency risk (Z-score), cost efficiency, banking sector development and stock market development and it has also found that these indicators has impact on banks profitability in MENA countries. Determination of profitability indicators are used return on assets (ROA), return on equity (ROE) and net –interest margin (NIM). Finally, this paper uses Lerner index and 3- banks concentration ratio (C3) to measurement market competition; we attain more sturdy results for the sake of the impact of cost- efficiency and competition on banks profitability. This study uses 3 method (Generalized method of moments, Least Squares and Generalized Linear Model) to justify this result. This study will help to financial authority for policy implementation of various forms of banks in MENA region.

The remaining part of this paper is structured as follows. Section 2 reviews of literature. Section 3 shows presentation of data and methodology. Section 4 explains the empirical results. Lastly, Section 5 Conclusions and Policy Making.

2. Review of Literature

There have a number of volumes of literature examining the profitability not only in the US banking but also the European banking industry. The outcomes refer that bank profitability has significantly influence by bank credit risk, liquidity risk, bank size, bank capitalization, bank efficiency, bank diversification, concentration, inflation as well as GGDP but some has significantly negatively impact such as credit risk, liquidity risk ad bank size. Table- 1 provides brief information about the empirical studies focusing on US and Europe.

Table 1. Review of literature on profitability

Data period	Areas of Investigation	Method and Methodology	Empirical outcomes	References
1985-2001	Greek Baning Industry	GMM	There has no proof in support of structure conduct performance paradigm in Greek-banking industry	[1]
1990-2002	Greek Banking Sectors	Fixed effect estimator	Not only higher capitalization but also lower cost ratio leads to greater profitability. GGDP and inflation also influence to bank profitability.	[45]
1992 to 1998	European Banking Industry	GMM and OLS	Capital asset ratio has a significantly & positively effect on bank profitability	[14]
1992-1998	European Banking Industry	Generalized Method of Moments	Bank diversification has a positive impact on bank profitability	[13]
1986-1989	European Banking Industry	Ordinary Least Square (OLS)	Liquidity risk has a is significant & negative concerned to bank profitability	[23]
1973-1978	US Banking Industry	Ordinary Least Square (OLS)	Size has significantly & negatively concerned to bank profitability	[34]
1994-1998	European Banking Industry	Fixed Effect Estimator	Credit risk has a negative impact on bank profitability	[22]
1994-2005	US Banking Industry	Generalized Method of Moments (GMM) and Ordinary Least Square (OLS)	Bank concentration contribute to increase profitability of bank	[42]
1980 -1989	US Banking Industry	OLS	Larger market share as well as various product contribute to higher profitability of banks	[3]

They investigated about Greek banking area over the period from 1985 to 2001. They said that there has no proof in support of structure conduct performance paradigm in Greek- banking sector. For this result, they used Generalized Method of Moments (GMM) [1]. They studied about Greek banking industry over the period 1990 to 2002. They refer that not only higher capitalization but also lower cost ratio leads to greater profitability of banks. They also refer that GGDP and inflation also influence to bank higher profitability. For identify this result, they used fixed effect estimator (FEE) [45]. They examined about European banking area over the period from1992 to1998. They found that Capital - asset ratio has a significant & positive effect on higher bank profitability. For detect this result, they used two methods Generalized Method of Moments (GMM) & Ordinary Least Squares (OLS)[14].

They examined about European banking area over the period from1992 to1998. They said that there has a

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positive effect of bank diversification on bank higher profitability. For detect this result, they used Generalized Method of Moments (GMM) [13].

They studied about European banking area over the period from 1986 to 1989. They said that liquidity risk has a significant and negative effect of concerned to bank profitability. For detect this result, they used Ordinary least square (OLS) estimator [23].

They examined about US banking sector over the period 1973 to1978. They refer that there has a significant and negative impact concern to bank profitability. For identify this result, they used Ordinary least square estimator [1,34].

They observed about European banking industry over the period from 1994 to 1998. They refer that credit risk has a negative effect concern to bank profitability. For identify this result, they used fixed effect estimator (FEE) [22].

They examined about US banking area from the period 1994 to 2005. They refer that Bank concentration ratio contribute to increase bank profitability. For identify this result, they used two methods Generalized Method of Moments (GMM) and Ordinary Least Squares (OLS) [42].

They studied about US banking area over the period 1980 to 1989. They refer that larger bank market share as well as various product contribute to higher profitability of banks. For identify this result, they used Ordinary least square estimator [3].

3. Data and Methodology

This part includes six segments where segment 3.1 Presentation of data and time border; Segment 3.2 Define the variables and source of variables as well as estimated effects on bank profitability; including four classes namely (1) Profitability indicators, (2) Industry specific variables, (3) Bank specific variables and (4) macroeconomic control variables; Segment 3.3 Assessment of competition in the MENA banking industry (Lerner index); Segment 3.4 Drives efficiency of cost in the MENA banking industry: Stochastic Frontier approach (SFA); Segment 3.5 Determination of z-score (insolvency risk) in the MENA banking sector; finally, Segment 3.6 Emphasis on econometric model to determine bank profitability.

3.1 Presentation of Data and Time Border

This study is prepared on the basis of bank data on MENA countries. It covers over the period 2011 to 2017. At first we have gathered 21 countries, 392 banks, and total observation 2758; 1820 Commercial banks, 805 Islamic banks and 133 Specialized Govt. Institution data from the MENA countries. After dropping missing data, we had a database of 19 countries, 256 banks and total observation 969, 634 Commercial banks, 298 Islamic banks and 37 Specialized Govt. Institution banks. As per the ownership structure, there are 3 ownership patterns in the MENA region. The bank-specific data as well as the industry-specific data are collected from the database of Bank scope. Macroeconomic variables are retrieved from database of the World Bank (data.worldbank.org).The data are not available information for all the year. For this reason, we use an unbalanced panel datasets so that we can keep persistence. We use 3 profitability indicators to measure profitability of bank which are ROA [1,12,37,38,40]; ROE [7,37,38,40]; and NIM [1,37,38,40].The bank specific determinant of profitability includes insolvency risk (z-score), credit risk, capital risk, liquidity risk, bank size, bank- diversification and cost- efficiency. The industry-specific variables include competition (Lerner index, C3), banking sector-development and stock market- development. Two macroeconomic variables are includes GDP growth rate and annual inflation rate. Finally, this paper uses Lerner index and C3 to examine competition. We get more vigorous results with concern to the effect of cost- efficiency and competition on bank profitability. The study uses 3 method (Generalized method of moments, Least Squares and Generalized Linear Model) to find out this robust result.

3.2 Define the Variables and Source of Variables as well as Estimated Effects on Bank Profitability

Table 2. Define the variables and source of variables as well as estimated effects on bank profitability

Endogenous variables	Definition	Expected Effect	Source
(1) Profitability - indicators	$(x+a)^n$		
Return on assets (ROA)	$\frac{net\ income}{total\ assets}$		[27,37-39]
Return on equity (ROE)	$\frac{net\ income}{shareholder's\ equity}$		[37-39]
Net-interest margin(NIM)	$\frac{net-interest\ income}{earning\ assets}$		[37-39]
(2)Industry- specific variables			
Bank competition (Lerner index)	$(P_{TAit} - MC_{TAit}) / P_{TAit}$	+	[2,9,10,11,16,17,18,19,21,26,33,38,39,41].
Bank competition(C3)	$\frac{total\ assets\ of\ the\ lagest\ three\ banks}{total\ assets\ of\ the\ whole\ banking\ industry}$	+	[38]

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Banking-sector development	$\frac{banking\ sector\ assets}{value\ of\ gross\ domestic\ product}$	+	[38-40]
Stock-market development	$\frac{maeket\ capitalization\ of\ listed\ companies}{value\ of\ gross\ domestic\ product}$	+	[38-40]
(3)Bank-specific variables			
credit risk	$\frac{impaired\ loans}{gross\ loans}$	-	[26,38-40,43]
liquidity-risk	$\frac{liquid\ assets}{total\ assets}$	?	[37,38]
Capital-risk	regulatory- capital ratio	?	[38,39,41,44]
Insolvency risk (Z-score)	$\frac{ROA + E/TA}{\sigma ROA}$	+	[2,5,24,29,30, 38,39,41,43,44]
Size	Natural logarithm of total assets	+	[26,38,39,41, 43]
Cost- efficiency	Stochastic frontier approach (SFA)	?	[25,38].
(4)Macroeconomic variables			
GGDP	Annual growth of gross domestic product rate	-	[28,43]; World bank
Inflation	Annual inflation rate	?	[43]; World bank
Here, notes: "+" denotes positive effect, "-" means negative effect, "?" represents no indication.			

3.3 Assessment of Competition in the MENA Banking- industry (Lerner Index & Concentration Ratio)

The Lerner index extent to market power which define as bank's price minus marginal cost divided by the bank's price. We used Lerner index as well as C3 to examine the market competition (market power) in the MENA countries following [2,5,9,10,11,16,17,18,19,21,32,33,38,39,41]. For calculating bank level data the Lerner index is used. The range is utilized 0 < Lerner < 1 for level of competition. At the point when the estimation of Lerner list is zero (0), it shows market power is lower but highly competitive. On the other hand, if the value of Lerner index is one (1), it indicates that market power will be more but less competitive.

Lerner index calculate as following:

$$Lerner_{it} = \left(P_{TAit} - MC_{TAit}\right) / P_{TAit}$$

Here, P_{TAit} represents the price of total assets MC_{TAit} indicates the marginal cost of total assets of the bank i at time t. Price indicates total operating income which calculates interest income plus non-interest income divided by total assets of banks i in time t, and Marginal cost (MC) determines by trans log cost function [5].

MC_{TAit} Translog cost function as follow:

$$InCOST_{it} = \beta_0 + \beta_1 InQ_{it} + \frac{\beta_2}{2} InQ_{it}^2 + \sum_{j=1}^{3} \gamma_{it} InW_{j,it} + \sum_{j=i}^{3} \delta_j InQ_{it} InW_{j,it} + \sum_{j=1}^{3}\sum_{k=1}^{3} InW_{j,it} InW_{k,it} + \varepsilon_{it} \quad (1)$$

Ln indicates natural logarithm and cost indicates total cost, Q_{it} represents total assets (output) for a bank i at time t.

W_j and W_k indicate W_1, W_2, and W_3.

W_1 indicates input prices of labor (*personal expenses to total assets*)

W_2 indicates Input prices of funds (*interest expenses to total deposits*)

W_3 indicates Input prices of fixed capital (other operating and administrative expenses to total assets).

Then, Compute as marginal cost:

$$MC_{TA_{it}} = \frac{Cost_{it}}{Q_{it}}\left[\beta_1 + \beta_2 InQ_{it} + \sum_{j=1}^{3} \varnothing_j InW_{j,it}\right] \quad (2)$$

3.4 Drives Efficiency of Cost in the MENA Banking Industry: Stochastic Frontier Approach (SFA)

Cost efficiency examines how a bank work well under the level environment condition concern to 'best-practice bank' which producing the equivalent output [4]. Cost efficiency measures for getting equal output, by reducing variance concern to benchmark bank with minimize cost. The cost efficiency level use generally from the cost function which express as translog function as follows [38]:

$$InCost_{it} = \beta_0 + \beta_1 lnassets_{it} + \tfrac{1}{2}\beta_2 (lnassets_{it})^2) + \sum_{j=1}^{3} \alpha_{itj} lninput_{itj} + \sum_{j=1}^{3}\sum_{k=1}^{3} \alpha_{itjk} lninput_{itj} lninput_{itk} + \sum_{j=1}^{3} \Upsilon_{itj} lnassets_{it} lninput_{itj} + v_{it} + \mu_{it}$$

Here, ln defines the natural logarithm. i represents a particular bank, and t represent a definite year of bank. Cost indicates the total cost; this study has taken one output which is total assets, on the other hand, input has taken three input prices (1) price of labor (personal expense divided by total assets) (2) price of fund (interest expense divided by total deposit) (3) price of capital (other operating & administration expenses divided by total assets). ν denotes the effect of statistical noise. μ represents the non - negative random disturbance term which taking the effects of inefficiency. Descriptive statistics of Lerner index

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shows in table 3.

Table 3. Descriptive statistics of Lerner index

Vari	N	Formula	Min	Maxi	M	Std.
Cost	969	Interest expenses plus non-interest expenses	-340 5.00	416320 7.00	6907 4.85	25520 5.40
Assets	969	Total assets	9.0000	19.0000	15.275	1.6754
input price of labor	969	(*personal expenses to total assets*)	0.0000	0.0000	0.000	0.0000
input price of fund	969	(*interest expenses to total deposits*)	0.0000	15.0000	.015480	.4818694
input rice of fixed capital	969	(other operating and administrative expenses to total assets)	0.0000	1.0000	.002064	.0454076
MC	969	Estimated using equation (1) and (2)				

Note: N represents number of observation; Min represents minimum; Maxi represents maximum; M represents mean and Std. represents standard deviation.MC denotes marginal cost, vari denotes variables.

3.5 Determination of z-score (Insolvency Risk) in the MENA Banking Sector

Return on assets plus CAP (equity divided total assets) divided by standard deviation return on assets as define as Z-score. Z-score uses to examine the insolvency risk of the study. Z-score provide the information about bank which bank is stable or unstable or less stable as well as provide the information which bank has the capability to absorb the losses. So, the higher value of z-score denotes the greater stability and lower risk. To examine the financial stability of financial institution like as (banks, insurance company) broadly used by [2,5,20,29,30,37-41,43,44]. The calculation of Z-score can be expressed as follows:

$$\text{Z-score} = \frac{ROA + E/TA}{\sigma ROA}$$

Here, ROA denotes return on assets of banks; E indicates equity of banks; TA represents total assets of banks; σ ROA stand for standard deviation return on assets.

3.6 Emphasis on Econometric Model to Determine Bank Profitability

For determining bank profitability a number of indicators (ROA,ROE,NIM) are used by Tan [37-39].We use three profitability indicators ROA, ROE and NIM to determine bank profitability. When we evaluate the bank profitability by ROA, ROE as well as NIM; we have faced a number of challenges. Firstly, higher profitable banks are able to take more equity through retaining profits. Secondly, assume that perfect capital market will be increased in capital to improve projected earnings. Some issues are arisen, unobserved heterogeneity across banks in MENA as well as modifications in corporate governance. Finally, profitability would be very sturdy for MENA banks due to political interference. We try to follow the model [1,38]; by using a two-step Generalized Method of Moments (GMM) to estimate profitability in the MENA banking industry. Finally, we are driving a model and expands the specification proposed by Tan [38] and which would be expressed as follows:

$$P_{it} = \alpha_0 + \partial\pi_{i,t-1} + \sum_{j=1}^{7}\beta_j X_{it}^{j} + \sum_{I=8}^{11}\beta_I X_{it}^{I} + \sum_{m=12}^{13}\beta_m X_{it}^{m} + \sum_{14}^{16}\Upsilon X_{it}^{b} + \varepsilon_{it}$$

Here, P denotes the profitability indicators ROA, ROE and NIM; i indicate the specific banks; t denotes the time for specific banks. α_0 denote the constant value.($\partial\pi_{i,t-1}$) represent the lag variable which shows lag profitability of one period. X denotes the endogenous variables. X^J denotes the bank specific variables. X^I represents the industry specific variables. X^m denotes the macroeconomic variables. X^b denotes the bank (dummy) variables; 3 dummy variables are Islamic Banks (ISBs) and Commercial Banks (CBs), Specialized Govt. Institution (SGI) represented by ISBs, CBs and SGIs respectively. ∂ denotes the speed the adjustment which leads to equilibrium and its range value 0 to 1; higher value indicate less competitive market and also indicate slower adjustment; lower value denotes more competitive and also denotes higher speed adjustment. β_J, β_I and β_m are coefficients to be estimated. The error term is represented by ε.

4. Empirical Results

This segment consists of three section; section 4.1 Position of cost efficiency in the banking sectors; section 4.2 Situation of competitive conditions in the MENA banking industry; finally, section 4.3The influences of risk, cost efficiency and competition on bank profitability.

4.1 Position of Cost Efficiency in the Banking Sectors

This section (table 4) shows the result about cost efficiency concern to ownership structure over the period 2011 to 2017.Islamic banks shows the highest cost efficiency with regard to Commercial banks as well as Specialized Government Institution; whereas, Specialized Government Institution shows the lowest cost efficiency. The outcomes display 0.352743, 1.413965 and 1.571398 chronically Specialized Government Institution, commercial banks

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and Islamic banks on examined time period. The result shows the different outcomes through equal inputs price. Specialized Government Institutions show the better cost efficiency among the banks. The results also inform about wastage 10.56%, 42.35% and 47.07% of their costs concern to the best price banks chronically Specialized Government Institution, commercial banks and Islamic banks. This result is contrast with the findings of Tan [38].

Table 4. Situation of Cost Efficiency in the MENA Banking sector (2011-2017)

v	2011	2012	2013	2014	2015	2016	2017	Ave	Per
ISB	0.4614	0.8811	0.6592	1.624	2.1701	3.2642	1.9385	1.5713	0.4707
CB	0.4771	1.8708	1.4965	1.3169	1.7026	1.6066	1.4269	1.4139	0.4235
SGI	0.0170	1.1438	0.0979	0.9011	0.1636	0.064	0.0808	0.3527	0.1056

Here, ISB= Islamic banks, CB= Commercial banks and SGI= Specialized Government Institutions; Ave= Average; Per =Percentage; V= banks.

4.2 Situation of Competitive Conditions in the MENA Banking Industry

This part (figure 1 and 2) shows the overall banking competitive condition in MENA region. Figure 1 explains the competition through Lerner index. The result shows that Specialized Govt. institutions and commercial banks take the highest market power over the period 2012 to 2016 but suddenly decline Specialized Govt. institutions 2016 to 2017 but Commercial banks keep their persistency; but both banks are slightly decline level from the period 2012 except 2015-2016 Specialized Govt. institutions. On the other hand, Islamic banks show the difference result from the others. The market power of its (Islamic banks) gradually increases from the beginning period till now. In figure 2 shows the overall assets of the largest three banks. The result shows that from the beginning to 2012 rapidly increase and 2012-2014 gradually increase but gradually decline from the 2014 to till now.

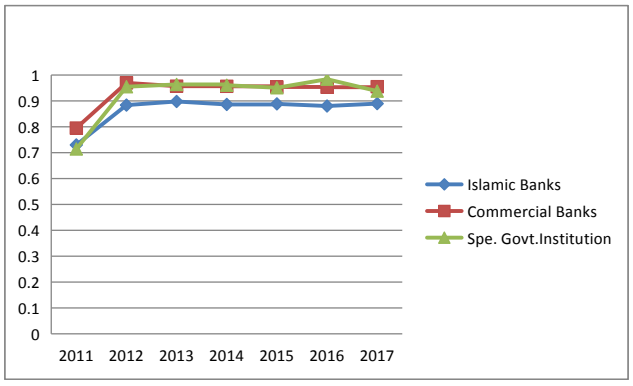

Figure 1. Competitive condition measured by Lerner index

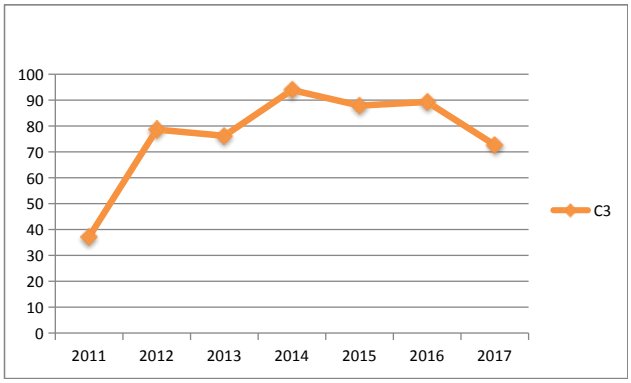

Figure 2. Competitive condition measured by C3

4.3 The Influences of Risk, Cost Efficiency and Competition on Bank Profitability

In table 5 represents the factors of bank profitability with an emphasis on the influences of Risk and Cost Efficiency. In table 6 focuses on the effects of risk and competition on bank profitability. Finally, in table 7 shows cost efficiency as well as C3 to test the effects of risk, cost efficiency and competition on bank profitability. Several profitability indicators are significant at the1%, 5%, 10% level by The Hessian tests. This specifies the explanatory power of the model is high.

From the tables 5 and 6 results expression that credit-risk is insignificantly & positively concern to bank profitability whereas 2 profitability indicators ROA & ROE use [35-36]; but credit-risk is positively and significantly concern to bank profitability when profitability indicator NIM is used. Our outcomes are difference with the findings of Tan [38]. We are used different econometric techniques in table 7 for this difference results. We further describe the insignificant positive effect of credit - risk on bank profitability when profitability indicators ROA & ROE are used but credit - risk is positively and significantly concern to bank profitability when profitability indicator NIM is used. This result suggests that larger volumes of credit- loan commit to higher bank profitability through large-scale of non-performing loans/impaired loans rises the banking cost & also precedes a decline in bank profitability. Actually, there has no impact between credit- risk & profitability whereas 2 profitability indicators ROA and ROE are used except NIM.

The results from in tables 5 and 6 display the liquidity- risk has insignificantly & negatively concern to bank profitability whereas 2 profitability indicators ROA and ROE are used but liquidity- risk is positively & significantly concern to bank profitability when profitability indicator NIM is used. The results are in contrast with Tan [38]. We are used different econometric techniques in table

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7 for this difference results. We further describe the insignificant positive effect of liquidity- risk on bank profitability when profitability indicators ROA & ROE are used but liquidity- risk is positively & significantly concern to bank profitability when profitability indicator NIM is used. The result (NIM) clarifies that larger volumes of loans commit to increase bank income & also expand profitability of banks. Howsoever, higher liquidity- risk which leads to decline in ROA & ROE. The negative influence of liquidity- risk on bank, ROE results are similar to [8]. Unfortunately, actually there has no significant relation between liquidity- risk & profitability of banks in MENA countries.

With regard to in table 5 and Table 6, Capital- risk is revealed to be significantly & positively concern to bank profitability when profitability indicator ROA is used, and significant negative concern to bank profitability whereas profitability indicator ROE is used, and insignificant negative concern to bank profitability when profitability indicator NIM is used. Our results are dissimilarity with the outcomes of Tan [38]); When profitability indicator ROA, ROE and NIM are used. We are used different econometric techniques in table 7 for this difference results. We further describe the significant & positive concern to bank profitability when profitability indicator ROA is used; and significant negative concern to bank profitability whereas profitability indicator ROE is used, and insignificant negative concern to bank profitability whereas profitability indicator NIM is used. For The sake of ROE & NIM of MENA banks, the negative effect can be elucidated by the ways (1) for the larger levels of capital, the funding cost may be declined of the banks (2) higher capital level may be encourage for lending or engage in prudent lending which lead to higher profitability of banks, (3) for collecting higher volume capital, banks need emphasis on own capital & reduce external loans. As a result, the dropping the volume of borrowing increases the bank profitability. We also find out that have a significant and positive effect of capital - risk on ROA; that refers lower levels of capital- risk (higher levels of capital) which lead to a lower ROA. The result states that higher volume of capital reduce the risk on assets & lower the equilibrium expected return on assets required by stakeholders.

In table 5 and in table 6 display that insolvency- risk is insignificant and positive concern to bank profitability when profitability indicator ROA is used and insolvency risk significant & positive related to bank profitability when profitability indicators ROE & NIM are used. Our outcomes are in contrast with the outcomes of Tan [38]. We are used different econometric techniques in table 7 for this difference results. We further describe the insignificant positive effect of insolvency - risk on bank profitability when profitability indicators ROA is used but insolvency risk is significant & negative concern to bank profitability when profitability indicator NIM is used. The result (ROA) shows that the effect of insolvency- risk on ROA is insignificant & positive, higher level of insolvency- risk lead to higher ROA and CAP (E/TA) which lead to higher banks profitability. Actually, there has no significant relationship between insolvency- risk & profitability when Profitability indicator ROA is used. On the contrary, the effect of insolvency- risk on ROE & NIM is significant but negative which indicate greater level of insolvency- risk which leads to a lower profitability of banks in MENA.

From table 5, in table 6 and in the table 7 shows that bank size is positive & significant concern to the bank profitability when profitability indicator ROE and NIM are used. The positive effect of bank size on bank profitability may be expounded; larger banks can reduce costs through economies of scale. As a result the, reduce the cost which leads to increase bank profitability. It's also revealed that bank- size has significant & negative concern to ROA. It may be clarified by the results that larger banks have greater ability to emphasis on non-interest generating businesses. By deducing the volumes of interest-generating activities reduces ROA which lead to lower profitability of banks.

With respect to bank-specific determinants of bank profitability, both in table 5, in table 6 and in the table 7 display the bank diver-sification has significant & positive concern to the bank profitability when profitability indicator ROA Tan [38] and ROE are used and negative & significant concern to the bank profitability when profitability indicator NIM Tan [38] are used. This outcome can be elucidated by the fact that bank- diversification decreases banks costs through economies of scope. By reducing bank costs which leads to a progress in bank profitability. That's why; larger volume of funds is invested by banks in engaging in other non-traditional activities due to the negative effect of diversification on NIM. By reducing the volume of funds for traditional loan-deposit services decreases bank income & further declines bank profitability.

The results from in tables 5 and in table 6 show that cost - efficiency has positive and significantly concern to bank profitability whereas 2 profitability dimensions ROA & NIM are used but significant & negatively concern to bank profitability when profitability indicator ROE is used. Our outcomes are in dissimilarity the outcomes of Tan [38]. We are used different econometric techniques in table 7 for this difference results. We further describe the cost- efficiency has positive and significant concern to bank profitability whereas 2 profitability dimensions ROA

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and NIM are used but significant & negative concern to bank profitability when profitability indicator ROE is used. The result (ROA, NIM) shows the effect of higher cost- efficiency which lead to higher ROA and NIM which leads to lower cost and ultimately lead to higher banks profitability in MENA countries. On the contrary, the effect of cost -efficiency on ROE is significant but negative which indicate greater level of cost- efficiency lead to a lower profitability of banks. However, in the table 6 Lerner index shows that Lerner index is significantly & negatively concern to bank profitability when profitability indicator ROA is used & significantly & positively concern to bank profitability when profitability indicator ROE is used and insignificant & positive concern to bank profitability when profitability indicator NIM is used. Our outcomes are difference with the outcomes of Tan [38]. We are used different econometric techniques in table 7 for this difference results. We describe the C3 has significant and negatively concern to bank profitability when profitability indicators ROA is used (same result in table 6) but positively and significantly concern to bank profitability when profitability indicator NIM is used. Unfortunately, insignificantly & positively concern to bank profitability whereas profitability indicator ROE is used. The result (Lerner, C3) based on ROA and NIM implies that MENA banks with higher levels of market power which indicate lower level of profitability. on the other hand, lower level of competition which lead to higher profitability. The result is in similar with Tan [38].

Both in table 5 and in table 6 display that banking - sector development have negative & significant effect on bank profitability when profitability dimensions ROA & NIM are used and insignificant & negative concern to bank profitability when profitability indicator ROE is

Table 5. The effects of risk-taking behavior and competition on bank profitability (cost efficiency only)

	ROA		ROE		NIM	
Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
(t-1) of dependent variable	4.91E-14***	8.764079	-7.64E-16**	-2.10777	1.07E-15	1.053382
Bank characteristics						
CREDIT_RISK	0.000378	0.084543	0.099462	1.499877	0.037159**	2.139123
LIQUIDITY_RISK	-0.00191	-0.69549	-0.05267	-1.2969	0.0167	1.569894
CAPITAL_RISK	0.007019***	4.532239	-0.03924*	-1.70855	-0.00844	-1.40366
INSOLVENCY_RISK	1.31E-05	0.888613	-0.00069***	-3.15821	-0.00038***	-6.70286
BANK_SIZE	-0.00134***	-4.53389	0.020269***	4.613805	0.002938**	2.553124
BANK_DIVERSIFICATION	0.004122**	2.489947	0.139463***	5.680143	-0.02463***	-3.82915
COST_EFFICIENCY	0.030707***	4.086762	-0.25236**	-2.26483	0.078352***	2.684325
Industry characteristics						
BANKING_SECTOR_DEVELOPME	-5.40157***	-2.14615	-41.8072	-1.12011	-27.9607***	-2.85974
STOCK_MARKET_DEVELOPMENT	7.09E-07***	3.371414	-3.03E-06	-0.97172	-2.24E-06***	-2.73689
Macroeconomics						
GGDP	0.000159**	1.945267	-0.0005	-0.41742	0.000523**	1.825963
INFLATION	0.000123*	1.601829	0.005306***	4.710341	0.003987***	14.83581
ISLAMIC_BANK	-0.00057	-0.27006	0.031138	1.002291	-0.01583**	-1.94497
COMMERCIAL_BANK	-0.0001	-0.05093	0.024321	0.802952	-0.02589***	-3.26323
SGI	0.000384	0.183527	-0.03731	-1.21251	0.010984	1.496174
C	0.032447***	6.310499	-0.21581***	-2.83031	0.063094***	3.158779
Deviance statistic	0.000139		0.030633		0.002102	
LR statistic	122.8912		86.42212		132.0293	
Pearson SSR	0.133304		29.31617		2.011702	
Dispersion	0.000139		0.030633		0.002102	
Prob(LR statistic)	0		0		0	
Pearson statistic	0.000139		0.030633		0.002102	
Probability	.000		0.0235		0.0073	
No. of observations	969		969		969	

Note: Table shows the GLM estimation results. Where return on assets (EOA), return on equity (ROE) and non –interest margin (NIM) are the endogenous variables for bank i and year t. The ROA(- 1),ROE (-1) and NIM (-1) are lagged dependent variables. Bank specific variable are credit risk, liquidity risk, capital risk, insolvency risk(the return on assets (ROA) plus equity divided total assets(E/TA) divided by the standard deviation of return on assets ratio σ (ROA) defined as Z-score, bank size, bank diversification and cost efficiency are main endogenous variables. Industry specific variables are banking sector development, stock market development also endogenous variables. Macro-economic variables are growth of gross domestic product (GGDP) and inflation. Dummy variables are Islamic banks. Commercial banks and Specialized government institutions. *Significance at 10 percent; ** 5 percent; and *** 1 percent level.

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used. Our results are dissimilarity with the results of Tan [38]. We are used different econometric techniques in table 7 for this difference results. We further describe the banking -sector development have negative & significant effect on bank profitability whereas profitability indicators ROA & NIM are used and insignificant & negative concern to bank profitability whereas profitability indicator ROE is used. The effect of banking - sector development on ROA and NIM are negative but significant which indicate greater level of banking - sector development which increase the cost lead to a lower profitability of banks in MENA countries. The outcome is similar with [6]. In table 5, 6 and 7show that stock -market development has a significant and positive effect on ROA Tan [38] of MENA banks which signposts the volume of non-interest business, increase significantly in a highly development stock market & that the income from these non-interest creating businesses contributes more than interest income to the overall income of MENA banks. On the other hand, stock -market development is a insignificantly and positively effect on ROE but significant negatively effect on NIM of MENA banks which lead to higher stock- market development increase the cost which lead to lower profitability of banks in MENA region.

In table 5, 6 and 7 results indicate that in highly inflation environment MENA banks take the higher profitability. The finding explains that inflation work well in this place and can to adjust in interest rate which increases the revenue & further increase bank profitability. During the time of economic boom in MENA resign, those banks can to achieve higher profitability (ROA*, ROE***, NIM***). We can also explain that the credit condition of banks is better during periods of economic boom. By reducing the volume of non-performing loans, banks can increase profitability. Howsoever, the result states that MENA banks take lower ROA during periods of economic boom. GDP

Table 6. The effects of risk-taking behavior and competition on bank profitability (Lerner index only)

	ROA		ROE		NIM	
Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
(t-1) of dependent variable	5.65E-14***	10.49831	-1.02E-15***	-2.975579	1.85E-15**	1.901358
Bank characteristics						
CREDIT_RISK	-0.00034	-0.07507	0.114205*	1.717316	0.036894**	2.108439
LIQUIDITY_RISK	-0.00337	-1.23264	-0.04306	-1.07184	0.01255	1.187277
CAPITAL_RISK	0.006858***	4.39662	-0.0397*	-1.72975	-0.00917	-1.51846
INSOLVENCY_RISK	8.47E-06	0.570571	-0.00064***	-2.94466	-0.00039***	-6.86434
BANK_SIZE	-0.00149***	-5.04837	0.020765***	4.77178	0.002426**	2.118292
BANK_DIVERSIFICATION	0.005909***	3.703671	0.131512***	5.601664	-0.01888***	-3.05576
Industry characteristics						
LERNER	-0.00613*	-1.73703	0.132363**	2.550796	-0.00112	-0.08172
BANKING_SECTOR_DEVELOPME	-4.97287**	-1.96327	-42.2993	-1.1349	-26.3304***	-2.68482
STOCK_MARKET_DEVELOPMENT	7.26E-07***	3.426835	-3.32E-06	-1.06329	-2.22E-06***	-2.70361
Macroeconomics						
GGDP	0.000153*	1.860968	-0.00033	-0.27645	0.000526*	1.826763
INFLATION	0.000136*	1.761424	0.005157***	4.579877	0.004011***	14.88552
ISLAMIC_BANK	-0.00215	-1.02175	0.050381*	1.623999	-0.01879**	-2.3014
COMMERCIAL_BANK	-0.0016	-0.78706	0.037903	1.269613	-0.02947***	-3.75142
SGI	0.001911	0.907283	-0.05662*	-1.84102	0.013548*	1.840607
C	0.042451***	7.215811	-0.36844***	-4.25611	0.076161***	3.343625
Deviance statistic	0.000141		0.03059		0.002118	
LR statistic	107.7145		87.9156		123.8985	
Pearson SSR	0.135204		29.27427		2.026835	
Dispersion	0.000141		0.03059		0.002118	
Prob(LR statistic)	0		0		0	
Pearson statistic	0.000141		0.03059		0.002118	
probability	0.0824		0.0107		0.9349	
No. of observations	969		969		969	

Note: Table shows the GLM estimation results. Where return on assets (EOA), return on equity (ROE) and non –interest margin (NIM) are the endogenous variables for bank i and year t. The ROA (- 1), ROE (-1) and NIM (-1) are lagged dependent variables. Bank specific variable are credit- risk, liquidity- risk, capital- risk, insolvency- risk (the return on assets (ROA) plus equity divided total assets(E/TA) divided by the standard deviation of return on assets ratio σ (ROA) defined as Z-score),bank size, bank diversification and are main endogenous variables. Industry specific variables are Lerner index, banking sector development, stock market development also endogenous variables. Macro-economic variables are growth of gross domestic product (GGDP) and inflation. Dummy variables are Islamic banks. Commercial banks and Specialized government institutions. *Significance at 10 percent; ** 5 percent; and *** 1 percent level.

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has positive growth on NIM which focuses on traditional interest -generating activities, which explains the non-interest generating business contributes more to the overall profitability of MENA banks. On the other hand, the time of economic boom, MENA banks emphasis on more effort & allocate extra resources to engage in traditional interest generating activities. However, ROA reduce, when the reduce volume of non-interest generating businesses. Whereas competition is examined by the Lerner index & C3 ratio, the result shows in one case (ROA) is same on banks profitability. This result suggests that the Lerner (ROA) and C3 (ROA) ratio are negative & significantly which representing lower competition leads to higher banks profitability. Unfortunately, We are found other two profitability indicators one case significant (ROE**; NIM***) and one case insignificant (ROE, NIM).

5. Conclusion and Policy Making

This study examines the elements of bank profitability in MENA with a focus on the effects of risk, cost-efficiency, & competition (Lerner, C3) on bank profitability. We use a sample of MENA (634 Commercial banks, 298 Islamic banks and 37 specialized govt. Institution) over the period 2011 to 2017. This paper try to keep contributes to the empirical literature by the follows: (1) it observes in the different kinds of risk, (2) usages more accurate measures of efficiency (Stochastic Frontier approach- SFA) and competition (Lerner index & C3). However, it affords more sturdy results with respect to the effects of cost efficiency & competition on bank profitability compared to Tan [38]). We find out that MENA banks have greater profitability in a lower competitive environment and various

Table 7. The effects of risk-taking behavior and competition on bank profitability (Cost efficiency & C3)

	ROA		ROE		NIM	
Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
(t-1) of dependent variable	2.58E-14***	10.25515	-6.53E-16***	-2.259967	-1.39E-15***	-3.195399
Bank characteristics						
CREDIT_RISK	0.000459	0.103105	0.09917	1.495042	0.036906**	2.129436
LIQUIDITY_RISK	-0.00089	-0.32244	-0.05633	-1.37558	0.013528	1.264322
CAPITAL_RISK	0.006562***	4.23201	-0.03759*	-1.62808	-0.00702	-1.16374
INSOLVENCY_RISK	1.24E-05	0.841322	-0.00069***	-3.14465	-0.00038***	-6.67683
BANK_SIZE	-0.00147***	-4.93096	0.02073***	4.666057	0.003337***	2.874778
BANK_DIVERSIFICATION	0.004174**	2.530553	0.139278***	5.67082	-0.02479***	-3.86266
COST_EFFICIENCY	0.029565***	3.944739	-0.24825**	-2.22428	0.081911***	2.808898
Industry characteristics						
C3	-0.01204***	-2.91252	0.043382	0.704555	0.037532***	2.332918
BANKING_SECTOR_DEVELOPME	-5.79976**	-2.30992	-40.3728	-1.07979	-26.7197***	-2.73509
STOCK_MARKET_DEVELOPMENT	6.97E-07***	3.327717	-2.99E-06	-0.95768	-2.20E-06***	-2.69769
Macroeconomics						
GGDP	0.000167**	2.046753	-0.00053	-0.44252	0.000498*	1.743355
INFLATION	0.000119	1.565039	0.005319***	4.720509	0.003998***	14.92531
ISLAMIC_BANK	-0.00026	-0.12616	0.03005	0.965806	-0.01677**	-2.06292
COMMERCIAL_BANK	-0.00035	-0.17037	0.025196	0.830921	-0.02514***	-3.17251
SGI	7.95E-05	0.038126	-0.0361	-1.17162	0.011978*	1.635163
C	0.041023***	6.943778	-0.24671***	-2.80419	0.036363	1.581888
Deviance statistic	0.000138		0.03065		0.002092	
LR statistic	132.3349		86.87304		138.0847	
Pearson SSR	0.132131		29.30096		2.000315	
Dispersion	0.000138		0.03065		0.002092	
Prob(LR statistic)	0		0		0	
Pearson statistic	0.000138		0.03065		0.002092	
Probability	0.0001 0.0036		0.0261 0.4811		0.005 0.0197	
No. of observations	969		969		969	

Note: Table shows the GLM estimation results. Where return on assets (EOA), return on equity (ROE) and non –interest margin (NIM) are the endogenous variables for bank i and year t. The ROA(- 1),ROE (-1) and NIM (-1) are lagged dependent variables. Bank specific variable are credit risk, liquidity risk, capital risk, insolvency risk (the return on assets (ROA) plus equity divided total assets(E/TA) divided by the standard deviation of return on assets ratio σ (ROA) defined as Z-score, bank size, bank diversification and cost efficiency are main endogenous variables. Industry specific variables are C3, banking sector development, stock market development also endogenous variables. Macro-economic variables are growth of gross domestic product (GGDP) and inflation. Dummy variables are Islamic banks. Commercial banks and Specialized government institutions. *Significance at 10 percent; ** 5 percent; and *** 1 percent level.

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natures of risk like as credit- risk, liquidity- risk, capital-risk, & insolvency- risk are related significant to bank profitability in MENA countries. This paper offers several policy implications not only the MENA government but also the banking- regulatory authorities: (1) MENA banks would also improve the process of managing and monitoring the loan business through reducing the level of credit risk which leads to higher profitability (2) MENA banks should decrease higher level of banking sector development. (3) MENA banks should commit to full use of available funds to engage in various types of businesses; if there is an issue of insolvency, strong governmental support will give protection to MENA banks.

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ARTICLE

An Approach to Find the Point of Buying Stock Based on Big Data

Yao Fu* **Congdian Cheng** **Lizhu Wang**

College of Mathematics and Systems Science, Shenyang Normal University, Shenyang, 110034, China

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ABSTRACT

It is a research subject that has attracted a wide concern and study for a long time to find a suitable trading point of stock. From the views of big data and quantization technique, the paper tries to propose an approach, through the form of algorithm, based on big data analysis and linear weighted moving average curve, to find the point of buying stock, so that the trader would like to achieve the expected profit with a higher probability; and makes the digital experiment to further explain the approach and verify its performance. This work can promote the development of big data research and quantization technique, and can also provide a certain reference method for the trader making the technology analysis of the trade.

1. Introduction

Since China developed its stock market, the scale has continuously expanded, the number of quoted companies has steadily increased. As the institutional construction has gradually perfected, the participants have become more and more. By the development of many years, now the stock market has become an important pillar of China's socialist economy with Chinese characteristics, which extremely adapts to the development of China's economy, and greatly promotes its prosperity, development and stability. The trade of stock has also become a major investment channel for China's people. Stock market is a huge complex system. A lot of theoretical work is needed to do for how to effectively build the system. Therefore, the China's stock market has received extensive attention and research since it came into being in the 1990s. For example, D.W.Tian discussed whether the reform of the divisional of stock right has an impact on the effectiveness of China's stock market, which provided a reference for the formulating of relevant policies [1]. S.Wang et al. predicted the feasibility of changes of stock price by Markov chain [2]. X.K.Li used the Copula function to analyze the correlation of Shanghai stock market and Shenzhen stock market [3]. X.L.Ren et al. argued the spillover effect of fluctuations between international energy market and China's stock market, as well make an empirical analysis [4]. R.W.Lin et al., based on multi-dimensional interactive verification, tried to predict the trend of the stock market from multiple dimensions and tested the method by establishing a relevant model [5]. X.P.Teng et al. proposed a method of predicting stock price trend based on the deep multiple regression model [6].

The moving average is often used to show the average level of historical fluctuations of stock prices, thus, to a certain extent, reflects the future development trend of stock prices. Therefore moving averages are an import-

**Corresponding Author:*
Yao Fu,
College of Mathematics and Systems Science, Shenyang Normal University, Shenyang 110034, China;
Email: fuyao0404@163.com

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ant tool for the technical analysis of stock trade, and it is an important aspect of the research area of stock market to explore buying point and selling point from the moving averages. B.J.Chen et al. analyzed the effectiveness of trading based on moving averages by designing two indicators, namely the prediction accuracy of the combination of buying point and selling point, and the cumulative rate of return [7]. B.B.Sun tested whether the moving average has the ability to obtain excess profits [8]. C.Y.Wang based on the theory of moving average analyzed the effectiveness of trend investment in the stock market [9].

Restricted by the technique of data processing, such as ingestion, storage and compute, the previous work that studies the buying point and selling point from the moving average has not been able to fully take advantage of the role of big data method and quantitative investment technology. Noting the situation, X.X.Xu et al., based on quantitative the technique, developed an algorithm to, through big data analysis and moving average curve, find the buy point of stock; and conduct a digital experiment to further explain the algorithm and verify its performance [10]. The main idea of the algorithm is to strenuously find a suitable scale δ so that, when the stock price is below the positive difference between the most recent daily average *MA* of a certain period and the scale δ, the buy of stock can obtain expected profits with a high probability. Therefore, we regard the region of stock price below the positive difference as a buying interval. In order to find the scale δ, we review the historical data of trades for a certain long period of time; and supposed that the stock is bought whenever its price is below (*MA*-δ),we test how many trading days can achieve the expected profit, and calculate the frequency of reaching the expected profit, which is believed as a success probability . If this probability reaches the expected level, the δ is regarded as the suitable scale. And otherwise, we change the value of δ and continue the preceding process to find it. The process completes until the suitable scale is found. The work of literature [10] makes full use of big data methods and quantification techniques, and to a certain extent, develops related work of previous research.

Due to the hysteresis of simple moving averages, the algorithm proposed by the literature [10] may be inefficient sometimes for it fails to make full use of the most recent information. On the other hand, due to no consideration of the loss with the failures in the process to find the suitable scale according to the expected success probability, the algorithm may be inefficient sometimes for the loss is too more. In view of this observation, the present work tries to develop the work of literature [10] by changing the simple moving average as the weighted moving average, and the finding suitable scale according to the expected success probability as the finding suitable scale according to the maximum total profit. We will, based on quantitative the technique, propose an algorithm to, through big data analysis and weighted moving average curve, find the buy point of stock; and conduct a digital experiment to further explain the algorithm and verify its performance.

2. Mathematical Programming

In order to clarify the problem that will be considered, we provide a preparation from the perspective of mathematical modeling in this section.

Let *S* be a stock. We denote P_i^l、P_i^h and P_i^c to represent the lowest price, highest price and closing price with trading day i respectively, and use $(i-j)$ to represent the *j*th trading day before trading day i. Here, $i-1$ refers to the first trading day before trading day i,$\cdots$, $(i-j)$ refers to the *j*th trading day before trading day i. We call

$$\overline{P}(i)=\frac{1}{1+2+\cdots+l}\sum_{j=1}^{l}P_{i-j}^{c}(l-j+1)$$

as linear weighted average stock price with the previous l trading days of trading day i; and call the smooth curve formed by the points $\{(i,\overline{P}(i))\}$ as linear weighted moving average curve, as weighted moving average for simpleness and clearness .

For stock S, assume that we buy one share in trading day i, and the period we hold shall not exceed f trading days. Use $O(i,f)$ to represent the profit in the future f trading days afterwards. We consider the problem how to make $O(i,f)\geq v$ with a high probability, and denote it as $\mathrm{S}\text{-}\mathrm{SPMP}(f,v)$, abbreviated as $\mathrm{SPMP}(f,v)$. Here v is an appropriate positive real number, which indicates the expected profit we hope to obtain.

Next, we tentatively establish an approach to solve the problem and conduct a digital experiment to further explain the algorithm and verify its performance.

Remark 1: In order to be convenience, for buying stock mentioned in present work, the number of buy is understood as one share. In practice, for to use the approach we proposed, the number can be adjusted through multiplying by the corresponding coefficient.

3. Algorithm

In this section, we try to, through establishing the follow-

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ing algorithm SPMO, propose an approach to solve the problem $\mathrm{SPMP}(f,v)$.

Obviously all the stock investor hope that the stock bought can get more profit within a certain period of time. A most popular approach is to buy stocks at the price below a certain moving average. It is a difficult question to tackle with that at what position in the region of stock price below the moving average we should buy the stock for, on the one hand, that the difference between the moving average and the buying price is less will result in the profit of buy stock reducing; on the other hand, that the difference is more will result in the chance to buy stock reducing. So, it is the bottleneck for the investors buy stocks according the approach to determine the buying point.

Given a problem $\mathrm{SPMP}(f,v)$, let

$$P_i^l, P_i^h, P_i^c, i = 1,2,\cdots,l+L+f,$$

be respectively the lowest price, highest price and closing price with trading day i for the latest $(l+L+f)$ historical data, and P_0 be the current price. We try to find an suitable $\delta > 0$ basing on these data such that it is possible to guarantee the profit v with a high probability within the next f trading days that the investors buy stocks when $P_0 < [\overline{P}(1) - \delta]$.

We use the intensive search method to accomplish this task. Take an appropriate small $\varepsilon > 0$. Then, we replay the trades, in turn, on L trading days $i = f+1, f+2, \cdots, f+L$, for

$$\delta = \varepsilon, 2\varepsilon, 3\varepsilon, \cdots, < \max_{f+1 \le i \le f+L} \{P_i^h\}$$

respectively. Assume P_i^l to be the current price when we replay the trade for trading day i. On the trading day i, we first consider whether the stock can be buy at a price lower than $[\overline{P}(1+i) - \delta]$, namely, $P_i^l < [\overline{P}(1+i) - \delta]$. If it is not possible, 0 is used as the profit of trading day i; otherwise, we further consider in two cases that the profit can reach v, namely $[\overline{P}(1+i) - \delta + v] < \max_{i+1 \le j \le i+f} \{P_j^h\}$; and the profit can not reach v, namely, $[\overline{P}(1+i) - \delta + v] \ge \max_{i+1 \le j \le i+f} \{P_j^h\}$. In the first case, v is regarded as the profit of this trading day. In the second case, $\{P_{i+f}^l - [\overline{P}(1+i) - \delta + v]\}$ is regarded as the profit of this trading day. For an δ determined , after the replaying trade completes for each of the L trading days, take the sum of the profits of each trading day as the total profit with δ for the L trading days, and indicated it as R_k, where $k = \dfrac{\delta}{\varepsilon}$. Finally, we find the k^* that satisfies $R_{k^*} = \max\{R_k\}$, and use $\delta^* = k^* \varepsilon$ as the δ we want to find.

From the states above, we can obtain the following observation. On the one hand, if the historical data used is less, namely l and L are too small, from the viewpoint of statistic, the found δ is too difficult to guarantee success of high probability, that is, when the investors buy stocks under the condition $P_0 < [\overline{P}(1) - \delta]$, they do not easily obtain profit v within the next f trading days, so the amount of historical data used should be sufficiently large. On the other hand, it does not meet the actual needs that the speed of calculation is too slow, so the speed of calculation should be sufficiently fast. That is to say, in order to effectively achieve the above ideas, we must use the big data technology. For processing big data at high speed, it is impossible to do without computers. Next, according to the above ideas, we design an algorithm SPMO to solve $\mathrm{SPMP}(f,v)$ with high probability, which can be executed by a computer and can better illustrate our method too.

SPMO Algorithm

Question: $\mathrm{S\text{-}SPMP}(f,v)$.

Input:

$$f, l, L, v, \varepsilon, P_i^l, P_i^h, P_i^c,\ i = 1,2,\cdots,l+L+f;\ P_0.\ \ (f,l,L,v,\varepsilon > 0)$$

(Here, f is the number of the trading days within which the investor expects to profit v, l is the number of trading days for $\overline{P}(i)$, L is the number of training days; v is the expected profits; ε is a parameter variable representing a kind of operation gap; P_i^l is the lowest price on trading day i, P_i^h is the highest price, P_i^c is the closing price on trading day i; $l+L+f$ is the number of historical data used; P_0 is the current price.)

Output: Yes (The investor can buy stocks at the current price); No (The investor cannot buy stocks at the current price).

Process:

(1) Calculate $\overline{P}(i)\ \ i = f+1, f+2, \cdots, f+L$.

(2) $k := 0;\ \delta := 0,\ \delta_0 := 0$.

(3) $k := k+1;\ \delta_k = \delta_{k-1} + \varepsilon,\ \delta = \delta_k$.

If $\max\{\overline{P}(i) - \delta - P_i^l;\ i = i+1, \cdots, L+f\} > 0$, go to the step 4; otherwise, go to the step 7.

(4) Put $R_k := 0$, then go to the step 5.

(5) For $i = f+1, f+2, \cdots, f+L$, proceed to the following items.

① If $P_i^l \ge \overline{P}(i) - \delta$, return to the step 5.

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② If $P_i^l < \overline{P}(i) - \delta$, proceed the next item.

③ If $\overline{P}(i) - \delta + v < \max_{i+1 \le j \le i+f} \{P_j^h\}$, put $R_k := R_k + v$; otherwise, put $R_k := R_k + (P_{i+f}^c - \overline{P}(i) + \delta)$.

(6) After completing the loop, return to the step 3.

(7) Find k^* such that $R_{k^*} = \max\{R_k\}$. Then, make $\delta^* = \delta_{k^*}$.

(8) If $P_0 < \overline{P}(0) - \delta^*$, output Yes; otherwise, output No. Stop.

4. Experiment

We take TongHuaShun (300033) of Shanghai stock market as an instance. The experiment selects 270 trading days from September 6, 2018 to October 22, 2019; takes the daily highest price, lowest price and closing price for each trading day selected as the original experimental data; chooses $l = 60, L = 120, f = 30, v = 4.5, \varepsilon = 0.2$, and takes respectively each trading day of 30 trading days from July 23, 2019 to September 2, 2019 as the current trading day and the lowest price of the current trading day as the current price. Then, in turn, for each current trading day, input the related data into the MATLAB program of algorithm SPMO and conduct the experiment. See the following and Table 1 for details.

(1) Take July 23, 2019 as the current trading day, or say trading day 0. On $i = 0$ (July 23, 2019), 1(July 22, 2019), 2 (July 19, 2019), …, $(L + f + l)$ (September 06, 2018), input the related data into the MATLAB program of algorithm SPMO, then obtain the result: No, i.e. can't buy , the profit is 0.

(2) Take July 24, 2019 as the current trading day, or say trading day 0. On $i = 0$ (July 24, 2019), 1 (July 23, 2019), 2 (July 22, 2019),..., $(L + f + l)$ (September 07, 2018), input the related data into the MATLAB program of algorithm SPMO, then obtain the result: No, i.e. can't buy , the profit is 0.

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(30) Take September 02, 2019 as the current trading day, or say trading day 0. On $i = 0$ (September 02, 2019), 1(August 30, 2019), 2 (August 29, 2019),..., $(L + f + l)$ (October 25, 2018), input the related data into the MATLAB program of algorithm SPMO, then obtain the result: No, i.e. can't buy , the profit is 0.

From table 1, it can be seen that among 30 trading days, 18 trading days can buy the stock TongHuaShun (300033), and can receive the profit v within the future30 trading days. The conclusion shows that the algorithm SPMO is effective and has certain feasibility.

Table 1. Summary of experimental results

Current date	Buy or not	Banefit v or not	Current date	buy or not	Banefit v or not
2019.7.23	No	----	2019.8.13	Yes	Yes
2019.7.24	No	----	2019.8.14	Yes	Yes
2019.7.25	No	----	2019.8.15	Yes	Yes
2019.7.26	No	----	2019.8.16	Yes	Yes
2019.7.29	Yes	Yes	2019.8.19	Yes	Yes
2019.7.30	No	----	2019.8.20	Yes	Yes
2019.7.31	Yes	Yes	2019.8.21	Yes	Yes
2019.8.1	Yes	Yes	2019.8.22	No	----
2019.8.2	Yes	Yes	2019.8.23	Yes	Yes
2019.8.5	Yes	Yes	2019.8.26	No	----
2019.8.6	Yes	Yes	2019.8.27	No	----
2019.8.7	Yes	Yes	2019.8.28	No	----
2019.8.8	Yes	Yes	2019.8.29	No	----
2019.8.9	Yes	Yes	2019.8.30	No	----
2019.8.12	Yes	Yes	2019.9.2	No	----

Remark 2: The experimental data above comes from the stock trading software of TongHuaShun. In the experiment, the lowest price of the current trading day is taken as the current price.

Remark 3: (1) The simulation experiment above is completed through the following two steps. Firstly, write the MATLAB program of algorithm SPMO. Secondly, for the related data selected, run the program to perform big data operations on a computer with model of Inspiron1427FT02 and CPU of Intel(R) Core(TM)2 Duo CPU T6500 @2.10GHz.

(2) The algorithm SPMO not only has many parametric variables, but also can quickly extract a large amount of data from the stock trading software, quickly carry out calculations, and timely answer the question whether investors can buy the related stock at the current price. So, it fully reflects the characteristics of big data technology.

5. Conclusion

Influenced by the boom of big data and quantitative investment, as well as the previous related research, especially the work of X.X.Xu et al.[10], the present work tries to based on quantitative the technique, established an approach to, through big data analysis and weighted moving average curve, find the buying point of stock, and then conducts an experiment to make a further illustration. The experiment made by us shows that the approach is effective. It is the issue worthy of further research to , from others ideas, develop the new algorithms for finding stock trading points with the big data and quantitative investment technique, as well as discuss the rate of return on the developed algorithm. We will continue to work hard. And meanwhile we extremely look forward to the present work can stimulate the interest of much friends so

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that more scholars can take delight in this research area together promoting the development of the research work of quantitative technology and trading technology!

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